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Y Power plants
U

WITHOUT A COAL PILE

In Shreveport, La., Natural Gas Makes Steam, to Make Electric Current, to Make Light. The Emergency Supply is Oil

SHREVEPORT, THE FAST GROWING city of northern Louisiana, has been forging ahead lately and the Shreveport Electric Light Co. has been having a hard time to keep up with growth. From the first installation of the plant, the problem has been to enlarge facilities fast enough to meet the demand and the evidences of this rapid growth and change. For instance in one place a gas holder which formerly was used to receive illuminating gas now does duty as a water tank and another one serves as a receiver for softened water. Belted units side by side with direct connected show the progress during the plant's growth. The wiring varies from temporary overhead stringing on glass suspended insulators to the very latest work carried under the floor in tile conduits. And the very latest devices Luminous Magnetite

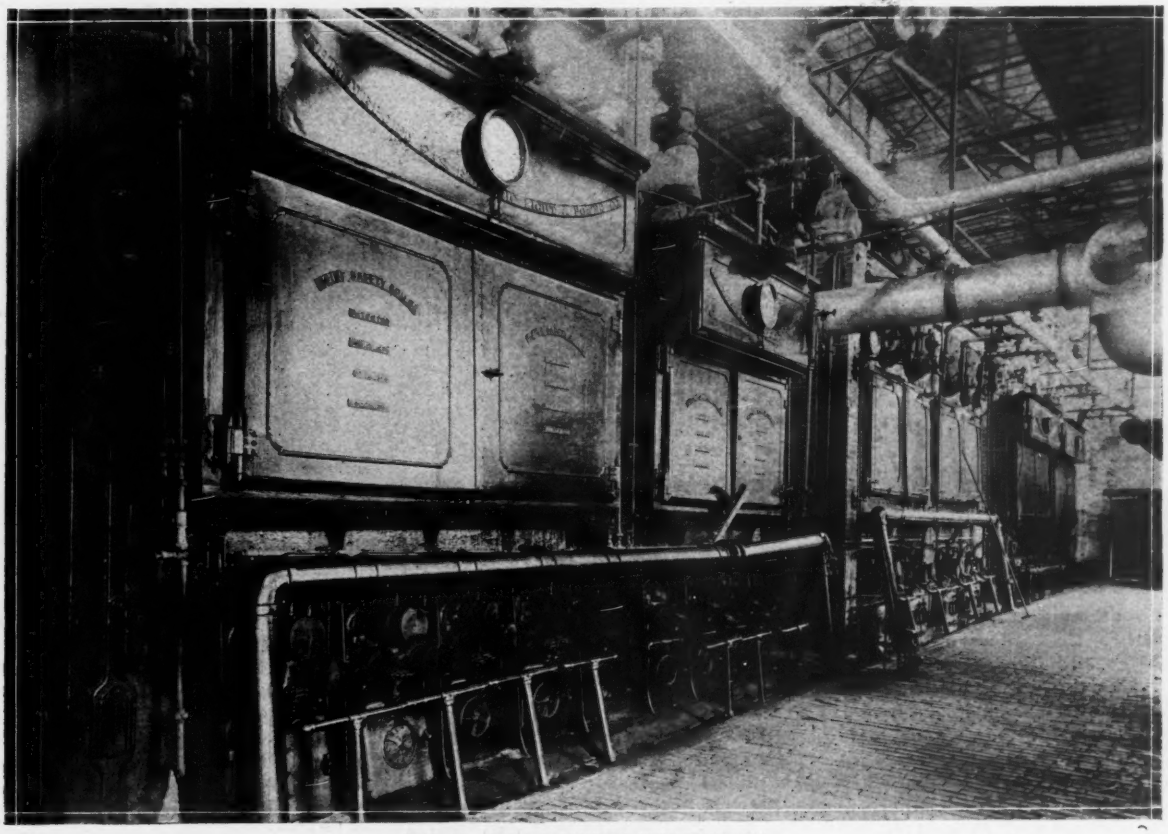


FIG. I. THE COALLESS BOILER ROOM

the effort is still going on almost unceasingly.

A casual trip through the plant reveals many of

lamps, and the combined unit mercury arc rectifiers for constant current are being installed for street lighting.

To a visitor from the coal burning region, the most notable feature in the station is entire absence of any coal pile, coal bins or coal supply of any sort and the freedom in the boiler room from dust of either coal or ashes. This comes about because Shreveport is situated in the region supplied by the Lake Caddo district, which is one of the most bountiful supplies of natural gas and oil in the South West. Gas is so cheap that where gas is used for street lighting, the street lamps are not even turned off in the day time, but are allowed to burn continuously. Oil likewise is cheap and this makes it possible to burn the natural gas under a boiler, to make steam, to use this in a steam engine for driving an electric generator and to transmit the electric current for power and light uses, of this fact, although it would seem that the relief from the labor of coal and ash handling would give plenty of time to the fireman to attend to such matters.

Current generated at 2300 volts, is transformed to 440 volts for power circuits and is transformed and rectified by combination unit transformers and mercury rectifiers for use in the arc light circuits for street lighting. Feed water comes from artesian wells; the natural gas ordinarily used as fuel comes direct through pipes from the gas field; and the oil, which is used as an emergency fuel, is kept stored in tanks buried underground in the station yard.

Fuel and Water

AT first sight, Fig. 1 looks as if the plant was shut down and the boiler room cleaned up for a deserted period, but such was not the case, for when the picture was taken the station was running with its regular

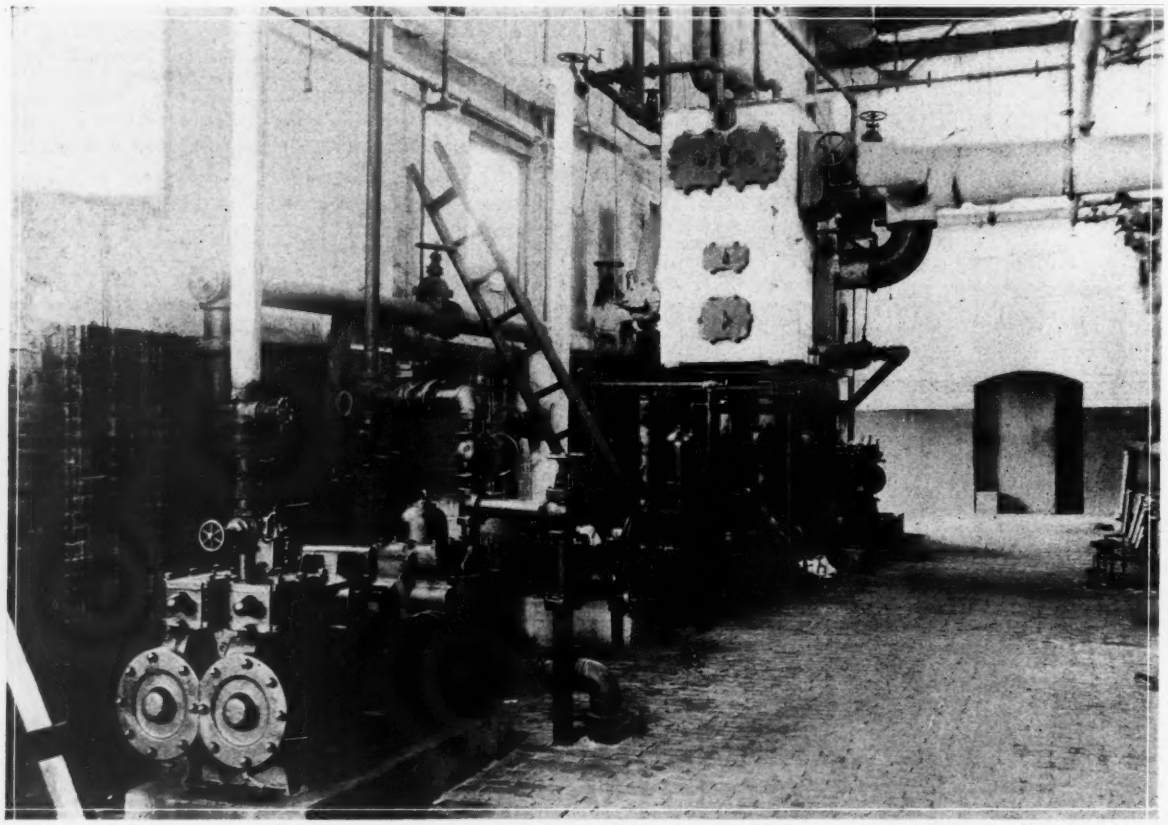


FIG. 3. PUMP AND HEATER EQUIPMENT

and all this transformation still proves more satisfactory than the use of the natural gas direct for power and light.

Cheap fuel is not always an unmixed blessing. While it is mighty comfortable to have no coal or ashes to handle and to have the cost of fuel low, the fact that these things are so makes a steam leak seem of less consequence than when each pound of steam blowing into the atmosphere means the handling of a definite amount of coal and ashes and the payment for expensive B.t.u. In the Shreveport plant, while the station is well arranged and well kept up, the steam leaks have escaped attention probably because day load and the firemen (?) were engaged in fixing some bearings on one of the main engines. The gas, which is supplied through argand burners attached to the larger upper pipe, which runs across above the firing doors, comes in at 10 oz. pressure and plays upon a fire brick checker work laid on top of the grates. Most of the air for the burners comes in and mixes with the gas in the burners but some air is supplied underneath the sloping fire brick arch in order to insure complete combustion. Twelve of these argand burners are sufficient to supply 500 hp.

For an emergency supply the oil, which is stored in 3 10,000-gal. tanks and which comes to the boilers

through the smaller pipes seen just above the ash pit doors in Fig. 1, is supplied under a 20 ft. head and sprayed by a steam jet at 70 lb. pressure. The oil burners are home made, consisting of a piece of 1 in. pipe 12 in. long, having through the center a ¼-in. oil pipe. The steam jet is 1/16 in. annular and with this arrangement 3 burners give sufficient heat for a 500-hp. boiler.

As stated above the water is pumped from artesian wells, by an air lift carrying air at 50 lb. pressure. The wells are from 200 to 300 ft. deep, those running about 200 ft. having good water with a slight amount of magnesia in it and those down to 300 ft. having a good deal of salt. The salt wells are used but little as they cause some difficulty in the water tubes of boilers.

For supplying the air a Clayton straight line compressor with Meyer valve gear is used and the water is discharged from the wells, as seen at the left of Fig. 1, into a tank from which it flows to the old gas holder beneath. From this holder it is drawn by either of 2 Marsh steam pumps and forced to the Kennicott water softening system from which it flows to the gas holder seen at the right of Fig. 2, having a capacity of 350,000 gal. Gas is kept above the water in this holder in order to keep the upper part of the holder out of the water and also to give a gas reserve and steadying chamber for the gas pressure.

drawn through a Cochrane open heater and from there passes through the pumps into the boiler feed line.

For house use, water is pumped by a Snow duplex pump to a tank on the roof, seen in Fig. 2, from which it is distributed by gravity.

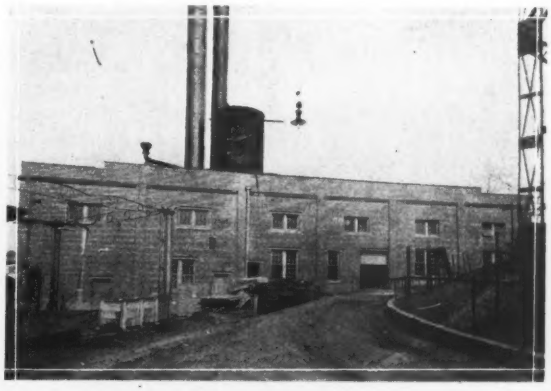


FIG. 2. OUTSIDE THE PLANT. AT THE LEFT IS THE AIR LIFT DISCHARGE AND GAS TANK USED AS RECEIVER. AT THE RIGHT IS THE FRAME OF THE GAS HOLDER USED AS A RESERVOIR. HOUSE SUPPLY TANK ON THE ROOF

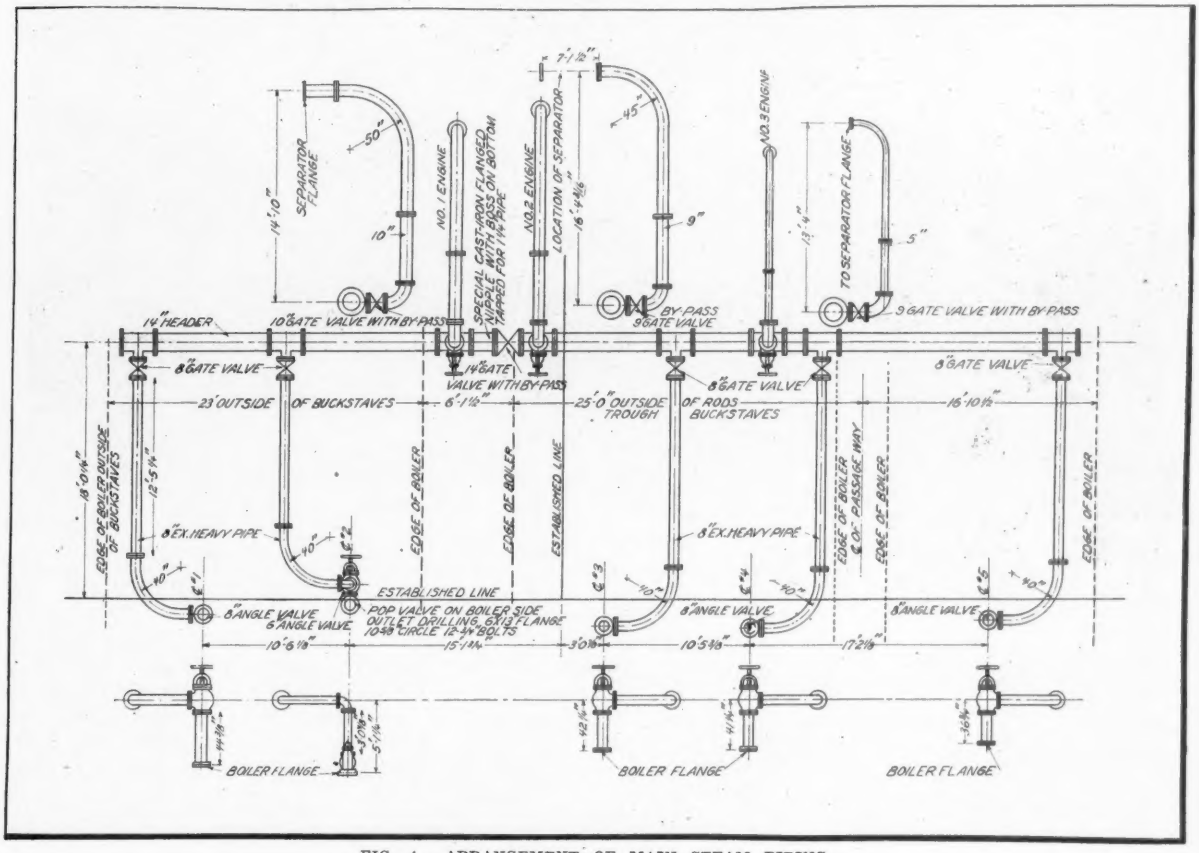


FIG. 4. ARRANGEMENT OF MAIN STEAM PIPING

Boiler feed is taken from this holder by 2 Snow duplex tandem compound pumps with outside packed plungers 8 by 12 by 6½ by 12 in. The water is

Oil for the bearings is pumped from the oil house to the engine room by an Oil Well Supply pump, of duplex type 10 by 16 by 12 in., the receiver in the

engine room carrying 2 hours' supply and feeding through Hills-McCanna 2-feed pumps in most cases. As a reserve pump for the house system an Alberger Pump Co.'s 2-in. volute centrifugal pump is driven by a Westinghouse 2-hp. induction motor running at 1710 r.p.m.

Boilers

SIX boilers are installed, 3 of them being 500 hp. capacity made by the Heine Safety Boiler Co., of St. Louis, 1 a 300-hp. boiler of the same make and 2 500-hp. boilers made by the Babcock & Wilcox Co., of New York. During the day pressure is carried at 120 lb. and during the night at 140 lb. These boilers are fully equipped with Ashton pop safety valves, Crane fittings and valves for steam, water and blowoff lines, Reliance safety water columns and Huyette self-closing gage cocks.

Steam from the boilers is carried through long radius bends to a common steam header, as shown in Fig. 4, and from the top of this header long radius bends conduct steam to the engines which are located on the other side of the partition wall in the engine room. Exhaust from the engines is carried through a common exhaust return to the Cochrane heaters which also take the steam from the auxiliary pumps. The plant is run non-condensing as no available supply of condensing water is at hand.

Generating Units

FOUR generating units are installed, numbers 1, 2 and 3 being belted and number 4 direct connected, all driving generators at 2300 volts alternating current. The main connection to units 1, 2 and 3 are shown in Fig. 4 and the connections to all of the units are shown in Fig. 5.

Number 1 unit consists of a Hooven-Owens-Rentschler engine, 26 by 48 in., belted to a General Electric generator with capacity of 101 amperes per phase and running at 360 revolutions, 3-phase. The exciter for this unit is belted to the generator and has a capacity of 72 amperes at 125 volts running 900 r.p.m.

Number 2 generator is driven by an Allis Chalmers engine, 26 by 36 in., of high-duty type at 100 r.p.m. The engine is of double eccentric construction with Barclay safety stop and governor. Number 3 unit consists of a Lane & Bodley 18 by 42 in. engine belted to a General Electric generator with capacity of 50 amperes at 600 r.p.m. and having its own belted exciter.

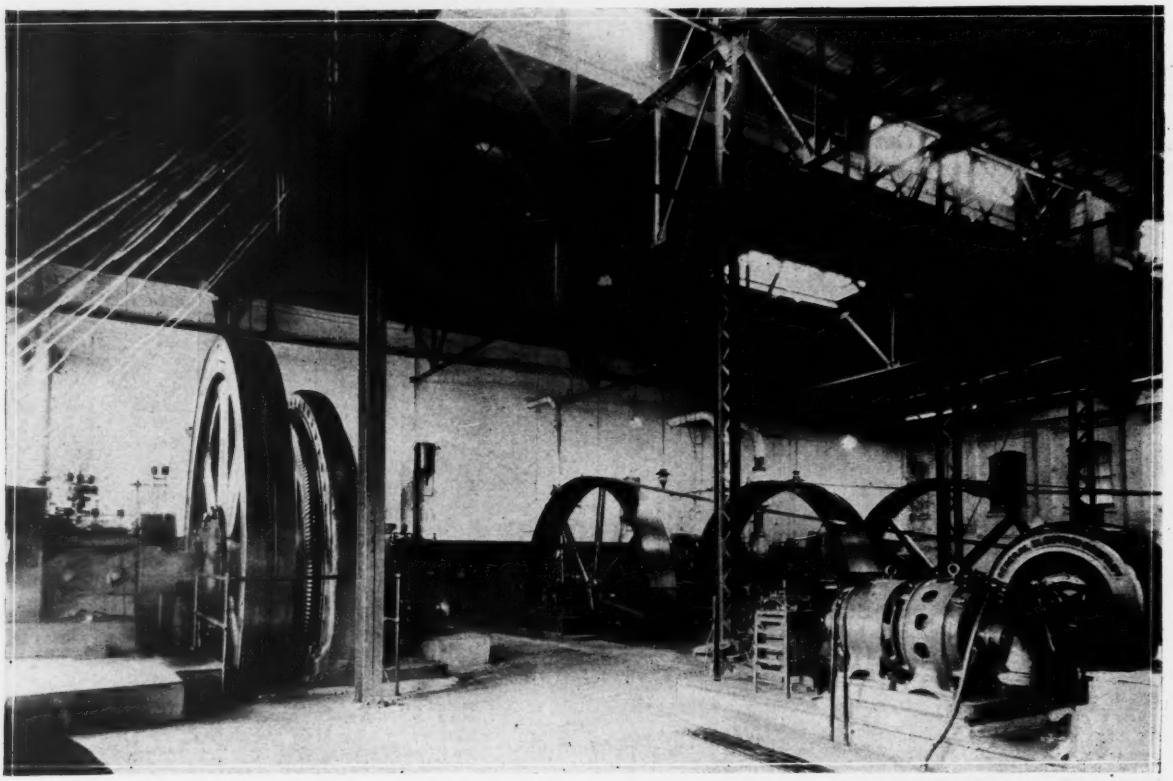


FIG. 5. IN THE ENGINE ROOM, SHOWING BELTED UNITS, DIRECT CONNECTED UNIT AND MOTOR-DRIVEN EXCITER

Number 4 unit is an Allis Chalmers direct connected engine, 28 by 48 in., with double eccentric of the heavy duty type and with spring loaded governor. It is direct connected to an Allis Chalmers generator of 150 amperes capacity and 100 r.p.m. On the No. 4 unit a central oiling system is used having a Burt unit filter located in the basement near the foundation of the engine and a pump which forces the oil from the clean oil receiver to an overhead tank from which it passes to all engine bearings. The exciter for this unit is motor driven, running at 850 r.p.m. and supplying 187½ amperes at 120 volts. The motor takes current at 2200 volts, 3-phase and has a capacity of 33½ hp.

Distribution System

POWER is supplied at 220 volts 3-phase from alternating-current mains. Light for houses and the incandescent lighting for stores are supplied from the 2300 volt mains by the use of transformers, while street lighting is by means of arc lamps. In the old installation tub transformers were used for changing from constant voltage to constant current and series alternating current arc lamps. The system has now been changed to use arcs which require direct current.

In order to secure this the transformers are combined with mercury tube rectifiers, Cooper-Hewitt type, rectifier and transformer being in a single piece of apparatus. There is also a starting device operated from the control panel board so that the throwing in of the circuit is practically automatic. Each of these transformers, 2 of which are shown in Fig. 7, and part of a third, has a capacity of 68 kw. at 2200 volts and delivers 4 amperes direct current to the outgoing line. The regulation is for 15 to 50 lamps on each transformer.

Switchboard

THIS is raised above the floor of the main station so that the operator can see all units at all times. It has 3 generator panels at the center of the board, of General Electric make and with the usual generator equipment, consisting of a fuse for each phase at the top, an ammeter for each phase, a voltmeter, a rheostat handle, plug switchs for voltmeter and synchronizer, a field switch and below an oil switch for control of the main circuit.

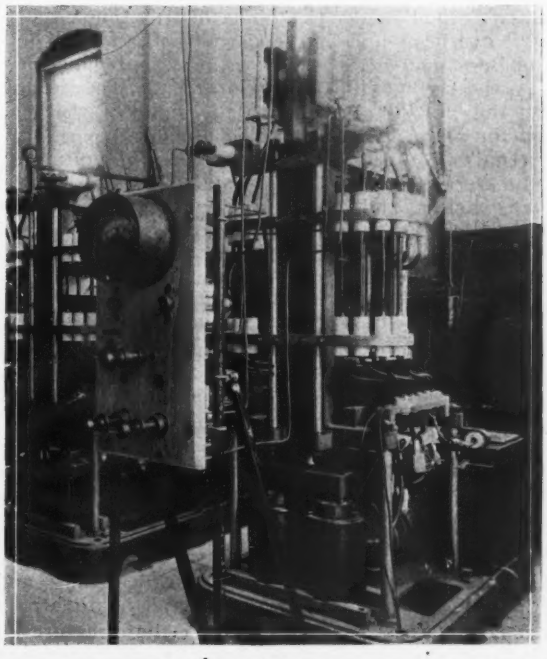


FIG. 7. RECTIFIER AND TRANSFORMER WITH CONTROLLING PANEL

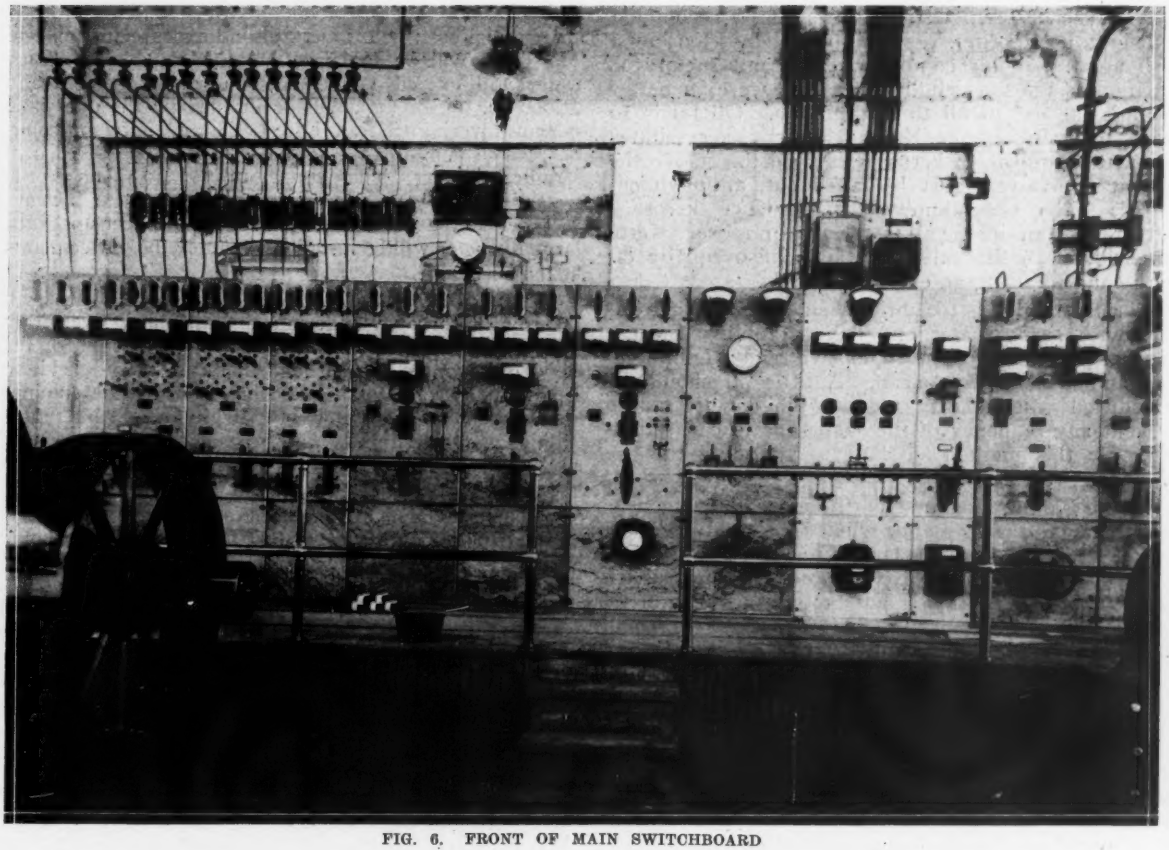


FIG. 6. FRONT OF MAIN SWITCHBOARD

To the left of the 3 generator panels are 4 circuit panels with ammeters, plug switches and main oil switches for distribution of the current to the various

circuits as may be desired. The distributing circuits are all overhead pole line construction, and the outgoing lines may be seen above the circuit panels.

To the right of the 3 generator panels is a blank panel not now in use and to the right of that the panel for No. 4 generator. The number 4 panel has the regular control devices, consisting of voltmeter, 3 ammeters, 3 rheostats for control of the motor driven exciter and the main generator field, the switches for the field and the rotary exciter, and at the bottom a wattmeter. A small panel at the right contains an ammeter, a relay, a main oil switch and a wattmeter, to assist in control of the No. 4 generator. Panels still farther to the right are for the control of the other exciter units and across the end of the main board to the right are the panels for controlling the tub transformers of the old street system that will shortly be thrown out. The control panel for each combination rectifier and transformer is located in front of its own unit as seen in Fig. 7.

AIR COMPRESSOR LUBRICATION

IN spite of the care exercised in designing and operating compressors, we still read of disastrous explosions, usually traceable to the pressure of inflammable gas of the air lines. Such a condition is nearly always due to the improper use of lubricating oils.

Lubrication of air compressors and pneumatic tools is a feature deserving careful attention. A common fault is to use too much oil and oil that has too low a flash point. An air compressor does not require as much oil as a steam cylinder; in fact it were far better to limit the use of oil to a minimum. Oil tends to cause the valves to stick and thereby necessitates frequent cleaning. If kerosene is used to remove the deposit the valves must be taken out, although engineers have been known to introduce kerosene through the air inlet valves for this purpose. Kerosene will clean the valves, but it is also equally effective in producing an explosion.

A sane method is to lubricate air compressor cylinders with soapy water and flake graphite. Such a mixture provides economical, efficient and safe lubrication and keeps valves clean. A little oil should be introduced when shutting down the compressor to prevent any tendency of the soap suds to cause rusting. By this method all dangers attending the use of oil are overcome.

Flake graphite has a strong tendency to attach itself to metal surfaces and, when thoroughly worked into the inequalities of surfaces, imparts a superficial glaze or veneering of great smoothness, high polish and endurance that prevents actual metal-to-metal contact, and makes it possible for relatively small quantities of fluid lubricants to provide a safe and sufficient film or lubricating layer.

Flake graphite is an inert mineral; its normal smoothness is quite unaffected by any degree of heat attainable in the air compressor cylinder. Under no conditions can it be volatilized, carbonized or baked into a hard or gummy mass to interfere with the free action of the valves. On the contrary, its presence upon working surfaces is a guarantee of smooth operation.

One of the best booklets on the subject is "Air Compressor Lubrication," published by the Joseph Dixon Crucible Company.

GREAT PROPOSED WATER POWER

PITTSBURGH capitalists have decided to go ahead with a scheme for a gigantic hydroelectric power plant, involving an expenditure of about $15,000,000. The site is 50 miles from Pittsburgh on the Clarion river, and the plant, it is stated, will generate 200,000 hp. The work is to be started as soon as the weather breaks next spring. Two dams are to be erected in the river, one at its mouth and the other about 35 miles up stream. The first dam is to be 259 ft. high and 1200 ft. across, of exceptional thickness at the bottom.

At a point where the first artificial lake ends, the other dam will be constructed. This dam will be 265 ft. high, about 1400 ft. wide, and will dam the waters of the river back for about 40 miles. An idea of the immense size of the reservoirs can be had from the fact that it will take from 8 to 9 months to fill it. The 2 dams will flood about 25,000 acres of land, and when completed, the artificial lakes are expected to form a nucleus for one of the finest summer resorts in western Pennsylvania.

Great natural advantages aid the construction; the hills adjacent are filled with rock suitable for dam construction; railroad facilities are good, and the construction work presents no feature of more than ordinary engineering difficulty.

A long distance transmission line will convey the electric energy to Pittsburgh, so that power cost in Pittsburgh will be greatly cheapened by this plant. The hydroelectric has the advantage of entailing but one large initial cost, with practically no expense for upkeep. The dams will be so large that the annual run-off of water will exceed 170,000,000,000 cu. ft. Practically 21,000 sq. mi. of area will be drained by the dual lake system, covering Clarion, Forest, Elk and Jefferson counties, which will alter the drainage topography of each in a radical manner. The plan as outlined is to dam up the water in the Clarion valley to more than 200 ft. Twenty feet below the surface of the reservoirs penstocks of large diameter will be installed to supply the power plants at the base.

The storage of the waters of the Clarion River will insure a uniform drainage into the Allegheny river from one end of the year to the other, a great portion of the flood drainage of the spring being caught and held, to be gradually let into the Allegheny during the summer droughts. At Kitanning the Allegheny will be kept 4 ft. higher during the low water season than now prevails; at Pittsburgh this is expected to result in the raising of the river at least 1 ft. during dry spells.

Plans for the plant have been under way for 5 yr., but no real steps could be taken until the charter was granted last June. Already, much preliminary work has been completed, but there remains the construction of a contour map covering every foot of territory of the lake area; the cutting of timber below the proposed line of the lake system, the establishment and marking of property lines, and the final details attendant upon the purchase of the great tracts of land necessary.

THE DEVELOPMENT OF THE petroleum-producing industry is limited in the more active oil fields by a somewhat restricted market for the product of the wells. The problem is being solved, however, by the rapid extension of the use of petroleum as fuel under locomotive and steamship boilers and in internal-combustion engines, in smelting furnaces, etc.——Mining and Engineering World.

THE STEAM TURBINE

Correct Piping Construction Necessary to Keep the Turbine Unit in Alinment

By W. J. A. London

WHILE getting perfect alinment in a turbine unit, when the machine is first erected is important, an obviously more important point is the maintenance of said alinment when the machine is heated up and in operation.

Because a machine is in perfect alinment when erected without its piping, or even sometimes with its piping but in a cold condition, it does not follow that the initial alinment is being maintaned when the machine is running; and the throwing out of alinment

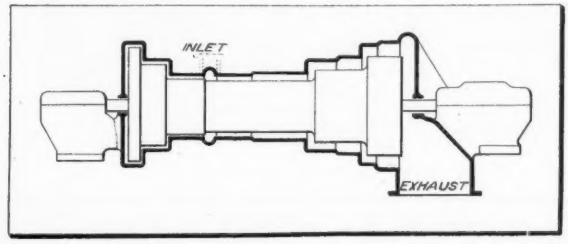


FIG. 1. ELEMENTARY SECTION OF PARSONS TYPE TURBINE

or distortion of the machine when running is often the cause of serious troubles. A careful consideration of conditions, layout of piping, etc., is necessary so that this may be avoided.

Piping Expansion

THE importance of the instructions issued by the turbine builder to the effect that "All piping connected to the turbine should have ample allowance for expansion so that no undue strain is thrown on the

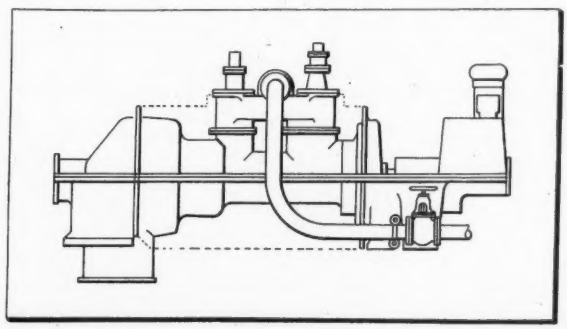


FIG. 3. STEAM CHEST ARRANGEMENT IN WESTINGHOUSE-PARSONS TURBINE

turbine," is not sufficiently realized. The engineer has probably been accustomed to piping up a reciprocating engine, the cylinder to which the steam pipes are connected being generally of a very substantial construction, rigidly connected to the base plate which in turn is well grouted into the foundations. When this engineer is confronted with the instructions above referred to, he is liable to look upon them as the ordinary instructions attending the erection of any steam piping and nothing more, and it may, therefore, not be out of place to enlarge somewhat on the reasons why conditions are so different in a turbine from what they are in a reciprocating engine. It is only by a full understanding of this difference by our readers and erecting men that this point will receive the necessary amount of consideration.

We have already stated that in a reciprocating engine the piping is connected to a solid mass of metal. In a turbine, however, instead of coupling up to a perfectly stationary member we are connecting our piping to a body that is more or less flexible.

While all designs of turbines are to a certain extent subject to easy distortion, the straight Parsons type is undoubtedly the worst. Figure 1 shows an elementary section through a Parsons turbine with the relative position of steam and exhaust pipes shown. It will be seen, to begin with, that the steam connection is made at absolutely the weakest point in the cylinder, also at a point where the smallest blade clearances exist. It is impracticable to support the turbine cylinder

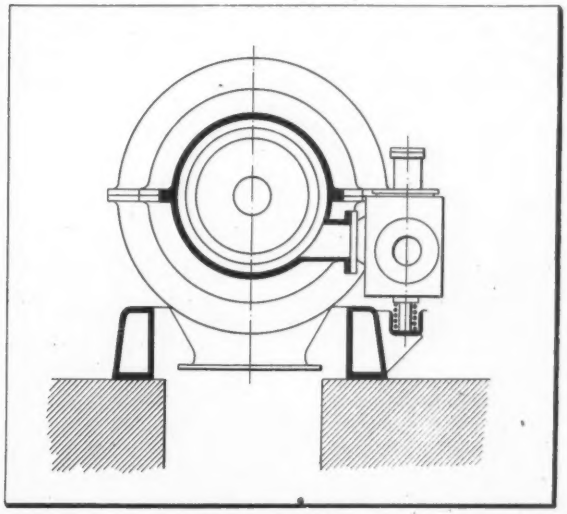


FIG. 2. STEAM CHEST CONNECTED TO SIDE OF TURBINE CASING

at a point adjacent to the steam pipe for the reason that were a foot fitted at this point the expansion between the bedplate and the center line of the turbine would, when running, be greater here than at the extreme end of the turbine, which would bend the cylinder. In a 500-kw. turbine the usual blade clearance allowed at this point is only 0.025 in. and in a 3000-kw. probably 0.05 in. It will be seen, therefore, that it will take very little external pressure to cause a blade strip.

The elimination of distortion in a turbine casing due either to internal or external forces has been the most difficult proposition the turbine designer has been confronted with. Where external weights in the form of steam chest, etc., have been added, all sorts of precautions have been taken to prevent distortion arising from this cause. Where the steam chest is connected to the side of the turbine, as shown in Fig. 2, some sort of spring support is fitted, designed as near as possible to carry the exact dead weight of the steam chest. If these precautions are necessary in the turbine itself, it is obvious that like precautions should be extended to the piping system.

The design employed by the Westinghouse Machine Co. in its straight Parsons design, as shown in Fig. 3, is probably the nearest approach to ideal conditions that is possible in this type of machine. To begin with the turbine case is substantially symmetrical and the steam chest carrying the governor valve, etc., is in a separate casting bolted onto the center of the machine, but the best point is the introduction of the flexible pipe which is supplied as part of the turbine and allows for expansion should the external steam piping be arranged without any allowance for this.

As mentioned above, the Parsons type of machine requires more attention in this respect than any other, but recent modifications to this design by the introduction of impulse elements, etc., to shorten and stiffen

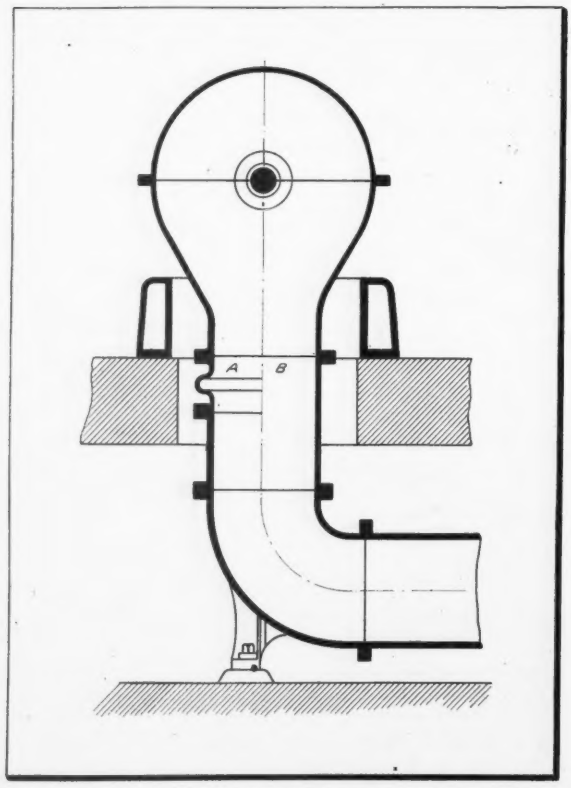


FIG. 4. ATTACHMENT AND SUPPORT OF EXHAUST PIPING

the machine are all tending to improve this situation. It must be borne in mind, however, that the light weight of turbine frames of all designs as compared with that of reciprocating engines of similar power makes the precautions mentioned necessary in all turbine work.

Condenser Connections

ARRANGEMENT of exhaust piping must also receive its due share of attention. In cases where the exhaust leads out of the bottom of the turbine directly into the condenser, an expansion pipe should, of course, be fitted between the turbine and the exhaust piping. If this is omitted and the turbine changed over from condensing to non-condensing, the difference in temperature will probably be sufficient to raise the whole turbine enough to cause serious trouble in the turbine itself. The expansion in 10 ft. of piping due to the difference of temperature between 29 in. and vacuum atmospheric exhaust is no less than 0.092 in., a serious factor where the distortion of a few thousandths of an inch may be sufficient to cause a shut down.

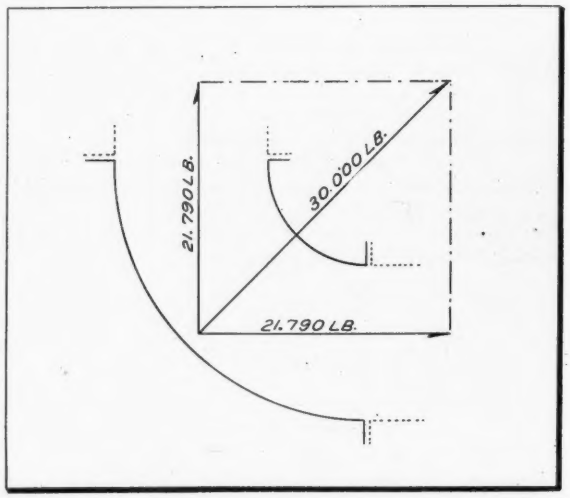


FIG. 5. FORCES ACTING ON AN ELBOW IN THE EXHAUST LINE

In the arrangement of piping as shown in Fig. 4 where the exhaust is led to, say, a common exhaust line or barometric condenser, an expansion pipe should, of course, be used, as shown at A, and the elbow should be firmly supported directly under the turbine, either by bolting and grouting into the foundations or by supporting it from the bedplate of the turbine. The arrangement as shown at B is sometimes use, but is undesirable inasmuch as the whole weight of the piping is taken by the turbine casing, and in a case of this kind the elbow must not be bolted to the foundations.

One other point that must not be forgotten, and that is, the extreme load that is thrown on large piping due to vacuum. Referring to Fig. 4, if an expansion pipe is fitted between the turbine and the elbow and the horizontal piping is so arranged that a further expansion joint is fitted in the horizontal pipe, the pull of this elbow will be sufficient to throw a heavy strain on the holding-down bolts. For instance, take a 3000-kw. machine with a 44-in. exhaust pipe and operating with a vacuum of 29-in., the vertical and horizontal pull due to this vacuum will each be 21, 790 lb. resulting in a component force in the bolts of 30,000 lb., see Fig. 4. The weight of the piping will of course help this out, but even when this is deducted it will be found that a considerable pull must be taken care of by bolts and foundations.

Piping to Pumps and Blowers

IN generating sets we have only the steam and exhaust piping to contend with, but when the turbine is connected to a pump or blower, the difficulty is increased materially.

In addition to the turbine piping proper we have, in the case of a pump installation, the suction and delivery pipes. The proportionate size and weight of these when compared with the main casing of the pump are often such as to make the holding or staying power of the pump itself negligible. The majority of pumping installations, of course, run in the smaller sizes of machines, where conditions are obviously much more severe than in the larger units. A good

example of the proportionate size of piping to the pump itself is shown in Fig. 6, which is a photograph of a typical turbine pumping installation. It will be clearly seen from a glance of this figure that the whole

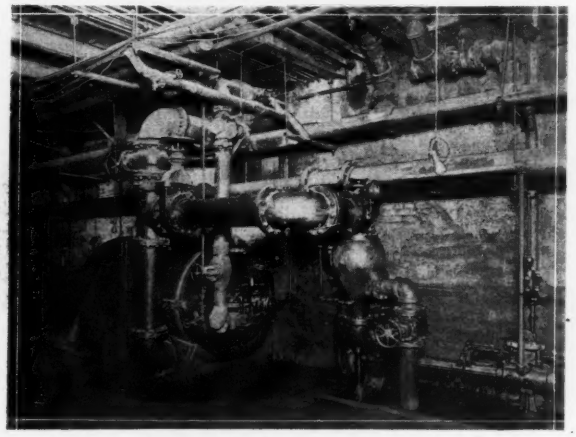


FIG. 7. PIPE CONNECTIONS IN A TURBINE DRIVEN BLOWER INSTALLATION

alinment of the outfit is dependent entirely upon the layout of the piping.

In blower work the piping used is rarely as heavy as that necessary in pump work, and again there is generally only one pipe instead of 2 connected to the machine, so that conditions are generally easier, but at the same time should be carefully taken into account when the plans are made. Fig. 7 shows a good example of a blower layout, the piping in this instance being by no means a factor that should be neglected.

While in pump work temperature differences are not as great as in the steam piping, they can easily be sufficient to throw the machine out of line. For instance, in a boiler feed pump, handling water at 200 deg., difference in expansion of the piping between starting up and normal running conditions will be 0,008 in. per foot of run.

Pipe Drainage

THE sizes of steam and exhaust piping are invariably specified by the turbine maker and where possible should always be adhered to. The drainage of piping should receive careful consideration, and while it is often stated that a turbine is immune from accident due to water hammer, this is a useless risk and of course should be avoided. The turbine should always be suplied with dry steam and in an installation where the turbine must be supplied with steam containing a certain percentage of moisture, an ample separator should be provided adjacent to the turbine. Wet steam has an erosive effect on practically all turbine buckets, and in addition to this the steam economy of the machine is affected very materially. Tests have shown that for each 1 per cent of moisture the steam consumption is increased 2 per cent.

In the final making up of piping, special care should be taken so that when everything is heated up to its normal operating condition the bolts on the various connections can be slackened and the joints rest comfortably together without having to force them either to or away from the machine itself.

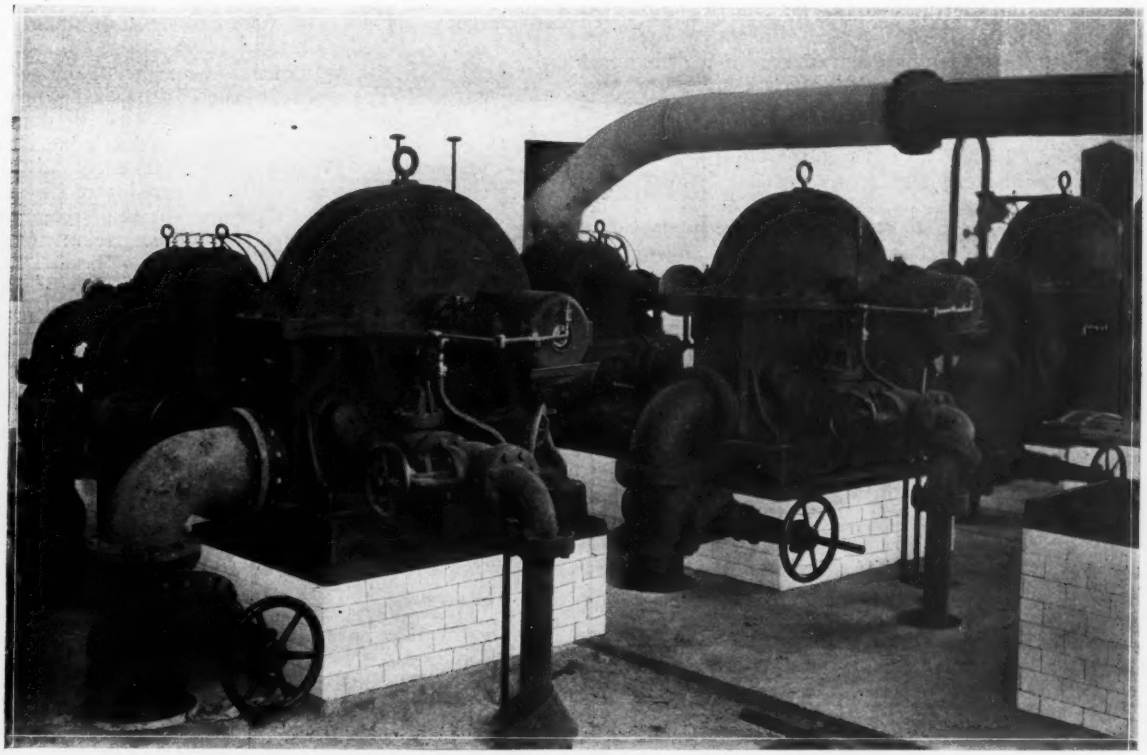


FIG. 6. TYPICAL TURBINE PUMPING PLANT FOR BOILER FEED, SHOWING IMPORTANCE OF PIPING TO SECURE ALINMENT

AMMONIA PACKING

By W. E. Sanders

TWO ESSENTIAL FACTS are to be kept clearly in mind when choosing or using rod packing for an ammonia compressor. First in importance is the large range of temperature and second the expansion or contraction of the packing due to a change in temperature.

Temperature Variation

A STEAM engine runs under practically constant pressure, consequently the temperature of the stuffing box is practically constant when the engine is running. Of course, the pressure in the cylinder varies during each stroke, but these variations are regular both in their range and recurrence, and are so frequent that their effect when the stuffing box is reached as to produce a comparatively constant temperature.

If an engine is shut down at night the stuffiing box becomes cold. When the engine is started up in the morning the stuffing box will leak and this leak will continue until the stuffing box has become thoroughly heated up. The cause of the leakage is that the packing at a temperature of about 100 to 150 deg. does not have the volume that it has when heated to say 350 deg. The expansion due to heat makes the packing tight and conversely the contraction due to lower temperature makes the packing fit loosely; hence, the leakage of steam.

The limits of temperature range in an ammonia stuffing box are much farther apart than in the case of steam and changes in temperature may in some machines occur very quickly, varying with the operation of the expansion valves and cooling system generally. A compressor may "freeze back," thus reducing the temperature to as low as 10 deg, or it may "run hot" to as high as 450 deg. Naturally the effect on the packing is very considerable and an engineer must slack off or tighten up on the stuffing box gland when hot or cold to compensate for the unusual expansion or contraction of the packing. And this must be as carefully watched and attended to as is the lubrication of the straps of a chattering eccentric rod. Every mechanic knows that a shaft or rod may "seize" in a bearing, but few perhaps realize that a packing may also "seize." Cases have been known where an ammonia packing has seized the rod so firmly as even to tear the stuffing box from the compressor head.

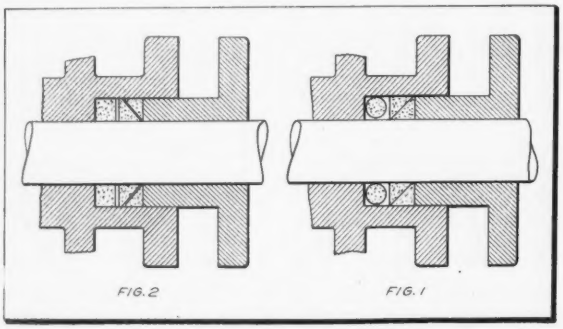


FIG. 1. SIMPLE DIAGONAL PACKING
FIG. 2. ALTERNATE SOLID AND WEDGE PACING RINGS

When a packing binds on a rod the excessive friction soon runs the temperature way up and usually to the detriment of the packing. Cast iron, brass, or similar alloy will be hurt the least. A soft metal, such as babbit metal, will soften and melt. A fibrous packing will smoke and burn, or rather carbonize, thus becoming brittle and "dead." Of a truth high temperatures "kill" fibrous packings.

To avoid any excessive and unnecessary grip on the rod the packing must be self-adjusting or of a construction that permits of quick adjustment. In metallic packings, the grip on the rod is usually obtained by the use of springs. If the rings are not beveled and are in segments the spring is generally of the "garter" type. When these are used there is usually clearance space enough about them to allow for all radial expansion. There should also be allowance for sidewise expansion between each ring and the slots of the cage so that the expansion of the rings may not bind them and thus prevent their free radial expansion or contraction. If metallic packing of the beveled ring type is used, again care must be taken that the action shall be free and easy, not only when cold, but also when very hot.

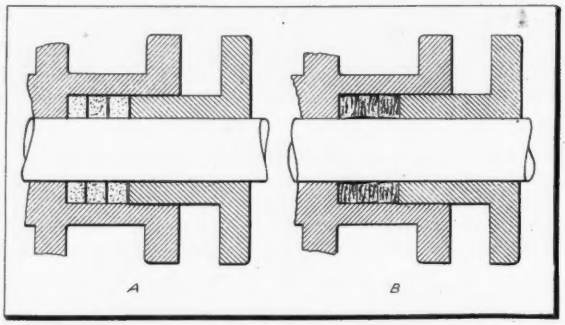


FIG. 3. SOLID RUBBER RING, A COMPRESSED, AND B RELEASED

Expansion Provision

FIBROUS packings are usually adjusted by tightening up or slacking off the stuffing box gland. Many types of packing are used and, if the materials be fairly soft and elastic, any of them may be squeezed up if cold, or allowed to expand along the rod when hot by backing off the gland, merely by virtue of their elasticity and softness. But there are 3 or 4 forms or combinations of packings that are most commonly used whose construction makes them quickly adjustable.

One of these is the "diagonal" packing. A diagonal packing consists of a cushion, which is toward the cylinder, and 2 wedges, the wedge touching the cushion being nearest the rod. These are surrounded by a sheath which serves to keep them in position while being inserted.

A glance at Fig. 1 shows clearly how a pressure from the gland will increase the width of the packing by forcing the second wedge away from the wall of the stuffing box and against the rod. On the other hand, the releasing of the gland permits this wedge to ease off from the rod.

Another wedge packing is really a combination of solid and sectional rings in alternation. The effect is the same as that produced by a diagonal packing and is brought about in the same way. Fig. 2 makes the operation clear.

Solid rubber rings are often used. A pressure by the gland flattens these rings and presses them against the rod. Releasing the gland allows them to expand in the other direction.

If rubber rings alone are used it sometimes happens that, as they are soft, the rings at one end may be tight while those at the other end of the box are loose. To prevent this, and to prevent their being worked back and forth, some manufacturers introduce solid tin rings between each 2 rubber rings. This is good practice and lengthens the life of the packing.

In choosing a rubber ring one has to depend a great deal upon the word and experience of the manufacturer. A pure rubber ring would not work well. Ammonia gas penetrates pure rubber and causes it to swell greatly. On the other hand, manufacturers have rubber compounds that swell very little and which at the same time are not easily affected by the oil which is always present. The ring should be a molded ring. When rubber is molded a firmer, more

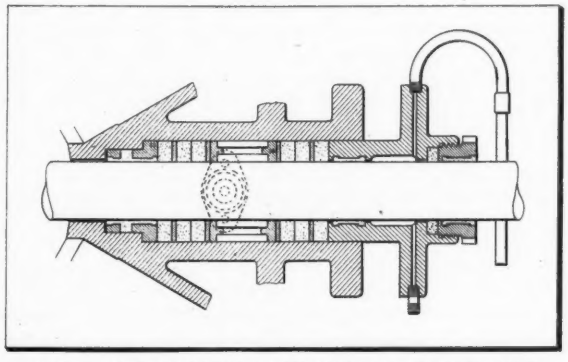


FIG. 4. ARRANGEMENT OF AN AMMONIA STUFFING BOX

even and compact surface is obtained than is possible by cutting, and such a molded surface is less easily penetrated by the ammonia gas and offers more resistance to the action of oil.

Lubricating Packing

MOST men prefer a quick death to a slow one. If a packing has feeling it might be of the same opinion. But in order to make the packing last as long as possible it is necessary to guard against quick destruction. The quick death that ever threatens packing is burning out. High temperatures carbonize organic materials. To prevent this, abundant lubrication is provided for ammonia packings. This prevents the carbonizing of soft packings and overheating of metallic packings. It is a fact that oil will rot rubber. But the rotting effect is a slow one, while burning out may happen in a few minutes.

To secure full and free lubrication, the long stuffing box, generally about 18 in., is divided roughly into thirds. Packing is placed in the 2 ends, but the middle third is occupied by a "lantern" or "spool." The flanges at the end of the "spool" allow it to slip easily in the stuffing box and yet fit easily on the rod. Inside the flanges the casting is cored out to allow the oil, which enters through perforations in the spool, to flow freely about the rod. Above and below the spool are 2 holes in the stuffing box. One is an inlet and one an outlet for the oil which is kept in circulation either by a small pump or by connection with an oiling system. On the outside of the gland is a stuffing box and a small gland known as a wiper gland, the packing in which is soft and acts only as a wiper to keep the excess oil from the rod.

In the stuffing box of the steam engine there is generally more or less of condensed steam that assists the packing by entangling the steam as it tries to escape. This effect is accomplished in the case of ammonia by the free use of oil. But even then ammonia is a light gas and will get out if any chance is offered. One should, therefore, be very careful to get packing that fits snugly, not too tight and not too loose.

In cutting the rings see that the ends of each ring do not meet around the rod. There should be a space of about ⅛ in. between the ends for each inch of diameter of rod. This allows for expansion lengthwise. Scarf the ends and stagger the joints of adjacent rings. If the ends do touch there is a strong possibility of "buckling" the rings and a buckled ring is of no further use.

In choosing a packing for ammonia the cost should be the last thing to be considered. Even a small leak of ammonia will, in a short time, cost more than the best of packing, not to speak of the annoyance it may produce. Choose the best and then give it careful attention. When you feel of the bearings about the machine inspect the stuffing box also, and do this regularly. If the cylinder is heating up, slack off on the stuffing box gland. When the cylinder is growing cooler tighten up on the gland. Always remember that when well treated a good packing will give long and faithful service and also that eternal vigilance is the price of peace.

REFRIGERATION EXPOSITION 1913

THIRD International Congress of Refrigeration, which is to be held in America during the month of September next year, was brought to this country through the medium of an invitation issued by the President of the United States under authority of a joint resolution of Congress and extended to the delegates in attendance at the meeting held in Vienna in 1910. The wonderful progress made in refrigeration methods will undoubtedly make this the most important congress yet held, and in order that the delegates and visitors may have every opportunity for practical comparison on matters affecting refrigeration and in keeping with custom, there will be launched an exposition of magnitude commensurate with the importance of the congress, and which will be held in Chicago during the period of the congress.

The organization of an association to put on this exposition is now under way and as soon as incorporated, the work will be commenced. It is the desire of the men behind the enterprise, who by the way, are the same men who have devoted their time and energy to the securing of this congress, that the industries that will participate in the cold storage division make all preparations now. The exposition being held in September makes it particularly necessary that the apple, fish and poultry interests utilize the present season to select and prepare their exhibits.

—The Tradesman.

ECONOMIC USE OF LUBRICATING OILS*

By David A. Corey

OIL costs money; it is an important factor in the successful operation of machinery. The lack of oil or failure to care properly for that in use is a serious matter and is, perhaps, more than any other one thing the cause of failure to secure maximum efficiency in machine operation; and that loss costs more money.

Selection of oils for the many requirements of a manufacturing plant is a matter which is worthy of, and is now receiving much more study than was the case a few years ago; and the purpose of many expert and practical tests is to determine what lubricants are best for high, medium, and low speeds, for light and heavy journal bearings, etc., and it is generally conceded that such tests are the only true means of definitely determining what oils render the best service under different conditions.

To make the saving and low costs of oils effective to the highest degree, it is necessary, after the selection of oils has been made, to provide suitable means for properly storing and issuing them. The common plan of keeping oil in barrels is especially wasteful. The loss by seepage, evaporation, absorption, non-drainage of barrels, and from faucets would be appalling if realized by the men

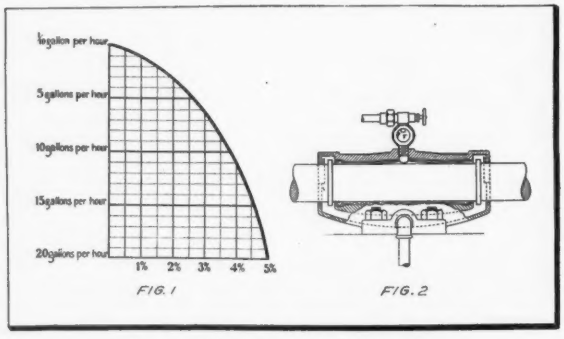


FIG. 1. FILTER SURFACE ECONOMIES
FIG. 2. STREAM FEED BEARING

who pay the bills. Practical tests in manufacturing plants by engineers who are constantly studying this subject show actual losses in lubricating oils of from 5 to 25 per cent., or 2 to 12 gal. per barrel of an average capacity of 50 gal.

An important phase in oil and manufacturing economy, when the character of machinery renders possible the necessary equipment, is the re-use of oil. To re-use oil it must necessarily have all impurities that will cause damage removed, else the re-use will result in actual loss. In many plants the oil used is caught and again used on rough work, where the impurities will do no appreciable damage.

It may seem that in such cases the loss has been well guarded against, and that any further saving would be too small to justify an investment or the spending of much time in its consideration; but lubrication economy means vastly more than the first cost, for the lubricant supplied may be entirely used up in service with virtually no waste or "drips," but this is not economical lubrication. Practice has demonstrated that there is always another item of expense besides the oil cost, and that is the cost of repairs or renewals due to injury arising from too scant lubrication, and this practice has coined the expression "sufficient lubrication."

In modern practice the so-called "sufficient" lubrication is no longer considered adequate; flooded journals are demanded and the highest economy requires the re-use of oil. No half way provision is tenable, and if oil is to be re-used, there is no object whatever in restricting its use. The expression "the more oil you use, the less you lose" is wholly correct, for oil losses are due to destructive distillation at the journal. A greater quantity of oil produces less friction, therefore less heat and less distillation loss. The friction losses are governed to a large extent by the quantity fed.

To secure satisfactory service in re-using oil it must be thoroughly cleansed. Old oil is not different from new if the impurities be removed. Petroleum oils never wear out, any more than water, but the lighter properties can be lost by distillation, which may occur at the temperature of an improperly lubricated journal, and to avoid this, it is necessary to keep journal temperatures low, or in other words, reduce friction by the use of large quantities of oil.

In the power plant the friction (and consequent fuel) loss is a very conspicuous item. To reduce this loss much oil must be used, and the amount of oil used will determine the saving possible in fuel. The saving possible in the engine room is frequently of such magnitude that an investment equal to the yearly coal cost would be justified, but as a matter of fact, only about one-tenth this amount is necessary to get the best possible results. Figure 1 demonstrates more fully the value of stream fed lubrication.

Ordinarily, 200 times as much oil can be fed upon the journals of an engine as would be the minimum amount possible. This chart shows the different savings when feeding different quantities, and when the total maximum saving is 5 per cent. For instance, if 5 gal. per hour be circulated, the saving would be 2½ per cent; if 20 gal. an hour be circulated it would effect a saving of 5 per cent, an amount which is invariably possible. The amount of oil shown in chart would be that required for a 750-hp. engine.

It may occur to the power user that since his machinery has not been equipped for stream fed lubrication, it would not pay in his case to arrange for such. It is doubtful if there are any such hopeless cases.

If the best practice is not obtainable, at least a far more efficient system may be employed than the existing scant or drop feed oiling, or the re-use of dirty oil. The physical conditions of the plant must determine just how perfect a system can be employed. The bearing shown in Figure 2 is one especially suited for stream feed and drips drained away, this permitting the highest possible grade of lubrication. The oil runs off the bearing and cannot be returned to it, until it has passed through a filter, and such impurities as would injure the journal removed. The collars on end of journal prevent the oil creeping along the shaft. This form (Fig. 2) is as safe against shut down as any system that can be devised.

Another method of increasing the efficiency of ring, collar, or chain-oiled bearings is occasionally to wash out the bearings and supply with clean oil. This is more troublesome and not so efficient as the piped system shown in Fig. 2, but it is probably the most efficient arrangement used at present for shafting, motors and the like. The great objection to this method is that so little attention is given to a journal after it has been filled with oil. Possibly once a month a little more oil is poured into the oil receptacle, and nobody ever thinks of cleaning it out. This is the use of dirty oil in its worst form. There is enough oil in the journal to keep it from melting out

*Abstract of paper read before The National Association of Cotton Manufacturers.

the babbitt, and that is about all the good that can be said of it. It produces much friction and causes much wear of the bearings.

By observation and comparison of the power required to drive a line of shafting and the idle running machines, first with clean and then with dirty oil, and knowing the length of time this loss was endured, it can be readily determined whether it pays to change oil every month, or oftener. If the saving in power alone is equal to the labor cost it would be justified as all other savings would be clear gain. But for heavily loaded, troublesome bearings, wherever they may be, some arrangement of flooded lubrication should be provided. If it cannot be connected to a central oiling system, then provide an individual system with possibly a rotary pump run by the machine.

The common method of distribution in mills is by means of tanks of 10 to 60 gal. capacity in the different departments, the sizes depending upon the judgment of the management; some preferring few large tanks while others prefer small tanks placed at more frequent intervals. The latter plan is very satisfactory as the small tanks can be removed from the mill for filling at the storage house outside, and in the mill are more conveniently located for the operatives.

When small tanks are used, several of them (4 or 6) can be transported on a truck to the storage room and returned in the same manner after filling. A tank of this kind should preferably be equipped with a non-overflow discharge, so that the oil cups can be quickly filled without spillage and without the usual accompaniment of waste which becomes saturated with oil, is thrown away, and becomes a fire menace.

Another method of distributing to tanks in the mill is by means of portable tanks, which are filled at the storage room, wheeled into the mill and the oil discharged into the permanent tanks by means of pumps.

A third method and one which is being largely adopted for certain factory uses and does away with transportation about the plant, is by means of long distance pumps operated by hand or power, located at convenient points about the factory and drawing the oils from one central storage point. The advantages of this system are manifest, especially where large quantities of oils are used in manufacturing operations, and measurements of the quantity delivered is desired. In utiliing any one of the plans suggested, to get the full value of the system the amounts issued to each department should be charged against that department, and to this the measuring features of the supply pumps are of great assistance.

Still another method of delivering and measuring oils and other liquids, is by means of an electric remote control system of pumps and measuring devices, used in manufacturing operations where considerable quantities are required in mixing, compounding, etc. The measures are automatic in delivering any desired or predetermined quantity.

INVESTIGATIONS HAVE been made at the German official testing bureau for materials to ascertain to what extent repeated melting of bearing metals influence their strength and reliability. As regards white metal (alloys of copper, antimony, and tin), it was found that repeated meltings did not noticeably alter the grain, but that the rate of cooling had a considerable influence. Quick cooling yielded a finer grain and higher hardness and strength, and the investigators recommend that white metals should not be heated to high temperatures, and that they should be cooled rapidly. Bronze, poor in tin, and therefore comparatively inexpensive, may have the hardness and strength increased by being rapidly cooled from a temperature of 1440° F.—Mechanical World.

THE ISOLATED WINS

The Story of a Practical Competition

By J. O'LEARY

THOSE who have dealing with a number of engineers are certain to encounter some of the pessimistic type, who declare that engineering as a profession—for it is a profession, judged by the amount of technical knowledge and trained abilitry which it requires—has seen its best days. They say that the public service corporation with its enormous facilities and resources, and its ceaseless efforts to extend the field of its operations, is a competitor too powerful to be successfully met, and that it is only a question of time, and a short time at that, when a few engineers at the central station will do the work of the many that are now operating the smaller plants. In support of their gloomy predictions, they point to some few places where the independent plant has already been swallowed by the central giant; and by dwelling on this dark view of the situation they fail to see that the light of opportunity is shining all around them.

As a matter of fact, if the giant corporation is abroad seeking whom he may devour among the isolated plants, there is also abroad the giant-killer in the person of the up-to-date and educated engineer, who can vanquish the public service giant whenever they meet in actual conflict. As, however, an ounce of demonstration is worth a pound of assertion, there is here presented the case of a well known Boston business house, whose experience proves conclusively that the isolated plant cannot only hold its own in competition, but can beat its burly competitor" to a frazzle."

In 1906 the great china importing and wholesale house of Jones, McDuffy and Stratton made a 5-yr. contract with the local public service corporation to furnish electricity for light and power throughout their building on Franklin Street. About the same time that the contract was made, the concern secured the services of Charles A. Hall as engineer, and thereby hangs a tale of interest to engineers generally, and to those imbued with fear of the public service corporation particularly.

Mr. Hall, not having the fear of the great corporation in his heart, began at an early date to collect and record data bearing on the question of cost. He took daily readings of the meters, weighed and recorded daily the amount of coal consumed for heating purposes, and kept systematic and accurate account of all items of expense in his department. As a result, he soon satisfied himself that the service rendered by the outside corporation could be secured at much less cost if he could induce his employers to install their own plant; and to this task he addressed himself with intelligent persistency and final success.

As time wore on, and opportunity offered, he took occasion to submit figures and arguments to prove that both economy and reliability would be subserved by the installation of a private plant for generating power and electricity. A breakdown in the service of the corporation on 2 or 3 occasions enabled him to show that the corporation's claim of infallibility of service was as unwarranted as its claim to superior economy.

When the 5-yr. term of the contract was drawing to a close, the judicious efforts of the engineer became apparent in results. The firm, which had been paying 9 cents per kw.-hr. for electric current, refused to renew unless a material reduction should be made in the cost of the service. Such reduction the service corporation declined

to make, being unaware of the situation developed by the well directed efforts of Mr. Hall. On this, Jones, McDuffy and Stratton at once got busy and contracted for the equipment advocated by their engineer.

The public service corporation now offered the reduction in price they had previously refused to concede, but were informed that the offer came too late, as a final decision to install the necessary apparatus for generating the service required had been reached. This constituted a complete victory for the isolated plant as far as the competition was concerned, but it remained to be seen whether or not the new plant would justify the claims made for it.

The plant installed may be briefly described as follows: There are 2 horizontal tubular boilers of 60 in. diameter, 17 ft. long; 2 duplex feed pumps, 5¼ by 3½ by 5, and a Cochrane feed water heater. There is a hydraulic elevator plant consisting of 1 tandem compound pump, diameter 16 and 24 by 18 and 11½ in. stroke; 1 simple pump 16 by 10 by 18 in.; this supplies water to 3 hydraulic plunger elevators at pressure of 150 lb. per square inch.

For the lighting plant there are 2 American Ball engines, one 12 by 11, running at 298 r.p.m., direct connected to a General Electric 3-wire, 220-volt direct current 50-kw. generator, and one 11 by 10 in., running at 305 r.p.m., direct connected to a 35-kw. generator. These furnish power for lighting and for a number of fans and small motors used throughout the building. This plant is run but 10 hr. a day and 6 days a week, which necessitates taking a small amount of current from the public service corporation for use after the plant is shut down evenings and Sundays. There is a Trumbull switch board, consisting of 3 panels, 2 of which contain the generator switches, rheostat and 2 General Electric circuit breakers. The center panel carries all the distributing switches, so placed that the engineer has control of any part of the building. It also carries a Thomson watt-hour meter of 300 amperes capacity. On top of this panel is placed the night switch that controls the outside extra service.

Installation of this plant was, of course, a matter of considerable expense, and even those of the concern who were most impressed by the representations of their engineer, were for a time on the anxious seat as to the financial result. Even though they were not from Missouri, they required to be shown that the economies promised were going to be realized, and a sharp watch was consequently kept on conditions in the new plant. Their anxiety was soon set at rest however, as the engineer, continuing his careful and systematic record of all items of expense and production, was able to demonstrate from the first, a saving of expense even greater than he had led them to expect. For example, his record by daily readings during the month of February last, showed 3133 kw.-hr. made, which at the rate of 9 cents per kw. hr., which was the price under the contract with the public service corporation, would cost $281.97. The coal used to secure this production was 31,330 lb., which cost $64.23. There was an expense for oil and waste of $5, making a total cost of $69.23. This shows a gross saving of $212.74. The showing for March was a saving of $241.86, and for May $249.71. Figuring in interest on the cost of plant, insurance, depreciation and repairs, it was found that there was a net saving of 50 per cent of the cost of service from the outside corporation.

This shows pretty convincingly what can be accomplished by the individual plant in the hands of a competent engineer, and yet it does not show all. During a considerable portion of the time, especially on bright days, the engines do not carry a load of more than ⅔ their capacity, so that adequate service to meet increase of business requirements is at hand and available without increase of operating expense.

Engineer Hall's concern is now so well satisfied with the demonstrated success of the experiment in self service, that they are prepared to meet any attempt of the public srvice corporation to renew their connection, with this response, "Unless you can supply current for 2 cents per kw.-hr. and guarantee uninterrupted service by a substantial cash forfeit in any case of failure, we would not consider a proposal to change."

In what has been done, Mr. Hall disclaims exceptional skill or achievement. He holds that any engineer who knows his business and works with system and diligence, can, if backed up by his employers, show equally good results. He is positive in the belief that in any case where a steam plant is required for heating and other purposes, it is not economy to depend for electricity on outside sources.

It is clear then, that there is no cause for gloom in the outlook. Croakers may croak and central plants may centralize for all they are worth, but the up-to-date engineer will remain "the master of his fate, the captain of his soul." Confident of survival with the fittest in the evolution of the modern power-plant, he will pursue with mind untroubled the even tenor of his way. Instead of viewing with alarm the portents of the central station, he will realize and demonstrate the possibilities of the isolated plant; and this accomplished, he may say —with apologies to the Noble Brutus—

> There is no terror Central in your threats;
> For I am armed so strong in competency
> That they pass by me as the idle wind
> Which I respect not.

DRAINING EXCAVATIONS

Novel Method of Removing Water from the Soil; Description of the Appliances Used

"BRINGA DA BRICK," "hurry tha mort"; these and other similar exclamations hurled through the air, together with the regular "chug" "chug" of a gasoline engine instinctively told the writer that not far away there was "something doing" of a lively nature in the construction line. This occurred a short time ago when strolling along Lake Shore Drive in Chicago.

The subject and object of this noise was the rapid construction of a trunk sewer. This itself, although interesting, was not the greatest source of pleasure to

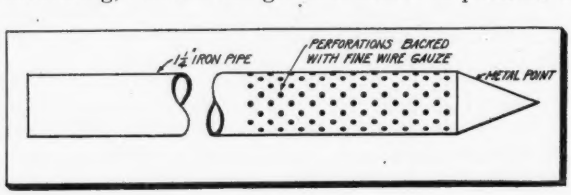


FIG. 1. DETAILS OF SAND POINT

those of engineering aspirations, but the appliances in executing and facilitating the work demanded chief attention.

In many localities in proximity to bodies of water one of the worst sources of annoyance in excavation work is the seepage of water into the places where earth has been removed. This is especially true where

the soil is composed of sand or gravel. To eliminate this trouble many devices have been used but one of the most novel methods was in use on the job where the sons of Southern Italy were so lustily calling for brick and mortar.

Method of Draining

THE main feature of what is known as the "Sand Point" system of pumping, which was there employed, is the sand point itself which is shown in Fig. 1. It consists of a 1¼ in. iron pipe about 10 ft. in length, or made suitable length for any particular job, open at one end which forms the top and enclosed by a sharp metal point at the other end which forms the bottom.

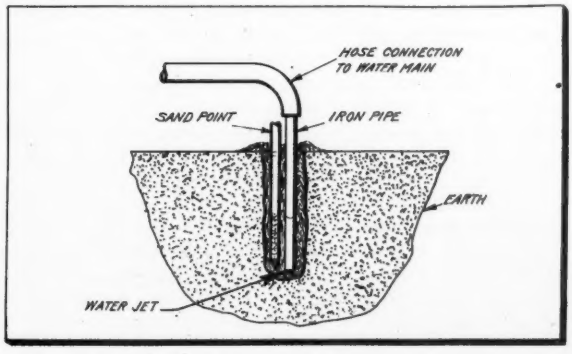


FIG. 2. METHOD OF FORCING SAND POINT INTO GROUND

For about 2 ft. from the bottom there are a great number of small perforations which are backed up by fine wire gauze. After the pavement is removed the points are inserted in the ground about 2 ft. apart, along the line of the proposed excavation, to a depth of approximately a foot below the bottom of the trench level. The manner of inserting the points is shown in Fig. 2.

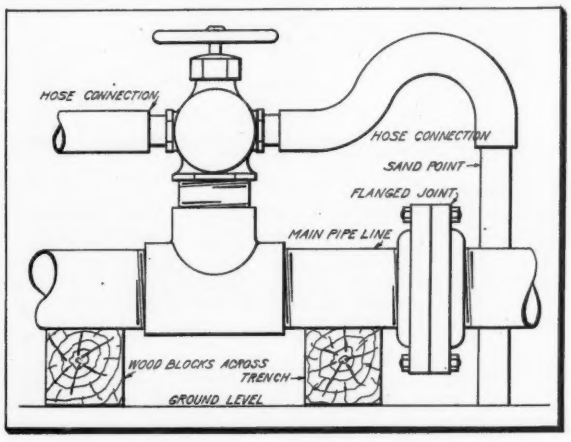


FIG. 3. ARRANGEMENT OF PIPE AND CONNECTIONS

A length of iron pipe is attached to a hose and connected to a near source of water pressure. The pipe is held in a vertical position with its end on the ground and the water jet gradually cuts away the sand or gravel and forces it to the surface. The sand point is inserted beside the jet tube until the desired depth is reached, when the latter is withdrawn. The manner of connecting these points to a 2 in. horizontal main is shown in Fig. 3. Approximately every 4 ft. there is a T-connection to which is attached a 2-way globe valve in which 1¼ in. nipples are inserted and connected to the sand point by a short length of rubber hose. Valves are spaced about 4 ft. apart and the main pipe is divided into approximately 10 ft. lengths, connected by flanged joints. By means of this construction, as fast as the laborers who are excavating approach the nearest "point," a length of pipe can be disconnected and carried forward to the front end nearest the power plant.

For excavations that extend only a short distance below the water level, one line of pipe and points is sufficient but where the excavation goes more than about 2 ft. below the water level, 2 lines are used.

Power Plant

THE power plant is mounted on a large 4-wheel truck that can be moved along the work as progress is made. It consists of a 10 hp. horizontal Fairbanks-Morse simple gasoline engine belted to a Goulds 7 in. by 8 in. triplex pump operating at 45 r.p.m., and having a capacity of 4 gal. per revolution or 180 gal. a minute. Gasoline is supplied from a storage tank

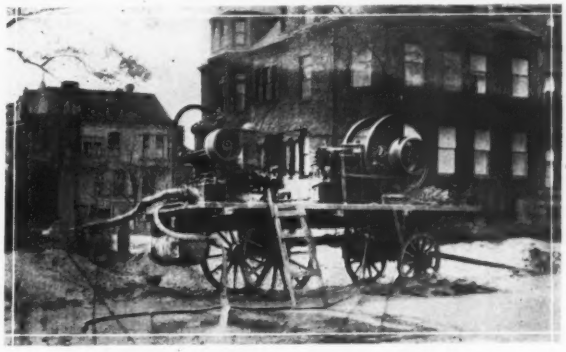


FIG. 4. POWER PLANT

mounted on the truck. The pump is connected to the end of the 2 in. main by a hose and discharges through a second hose into the sewer. The power plant is shown in Fig. 4.

M. J. McNamara, general contractor of Chicago, devised the system and it has proved to be a great aid in contracting work.

TO PAINT GALVANIZED IRON

VERY few paints seem to adhere to galvanized iron, says an exchange, but flake off in a short time. A prominent chemist has said that red lead gives the best satisfaction of any paint as a first coat for this class of work. It is found that a wax solution added to the unmixed red lead paint prevents scaling and cracking, as it tends to prevent cracking resulting from contraction and expansion of the metal. The formula for the wax solution is: Melt a cup of beeswax and when it reaches a thin fluid, pour it into a gallon of raw linseed oil heated to 200 degrees F. For use, add one quart of the solution to every 100 pounds of mixed red lead paint. When uncertain as to the durability of paints a good plan is to have a number of test sheets painted with the different kinds and so placed that they get the full heat of the sun's rays during the hot days of the summer.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

MODERN MOTOR APPLICATIONS

Applications of Motors to Punches and Shears, Wheel Presses and Draw Bridges

ECONOMY of floor space, always an important item, is particularly so in a machine shop when it is desired to install any additional tools. Fig. 1 indicates how this may be effected in the case of a motor-driven punch and shear press, made by the Cleveland Punch and Shear Works, Cleveland, Ohio. The arrangement of overhead gearing renders it possible to make a compact machine and one that is economical of floor space.

Machine complete with its motor weighs approximately 50,000 lb. It is designed for very heavy work, having sufficient capacity to shear 12 in. of 1½ in.

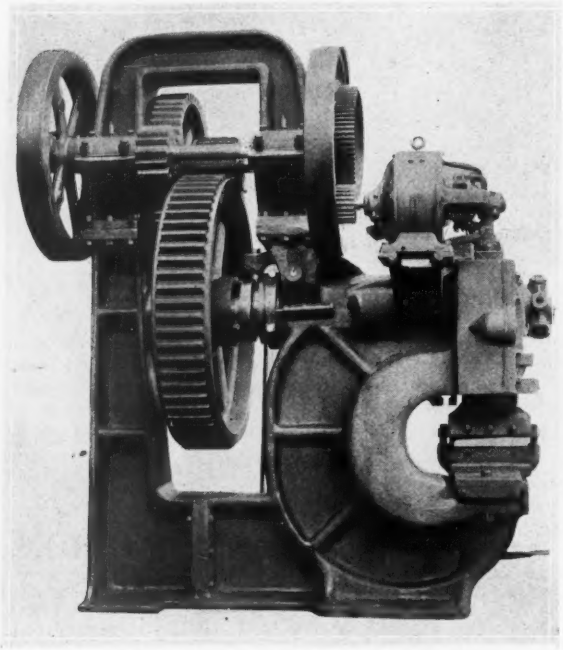


FIG. 1. PUNCH AND SHEAR PRESS

flat bars, and to punch a 5 in. hole in 1½ in. plate. The various attachments such as those for angle shearing, bar shearing, and punching are interchangeable.

The motor is direct current of 25 hp. capacity at 230 volts, of the commutating pole type.

Portable Shear, Motor Operated

A NOVEL motor application is shown in Fig. 2. It is a John Evans' Sons' shear mounted with its driving motor on a small flat car. The places where this machine may find a use are limited, but it is a valuable adjunct to wholesale hardware houses, factory storerooms, railroad shops, or in any place where metal bars or strap is handled.

The car is designed for standard gage track, being propelled by the hand wheel. The car is run along on tracks, in front of the bins containing the material, to any particular point where the required lengths of the desired material are cut.

It is equipped with a 7½ hp. motor operating on 3-phase, alternating current. The current is conveyed to the motor by means of a long flexible cable, or, when used over a track of any length, a number of junction boxes for making connections to the motor is more satisfactory.

Motor Driven Hydraulic Wheel Press

BESIDES being used in all car and locomotive works a wheel press is now considered indispensable to the equipment of steam and electric railways, lumber

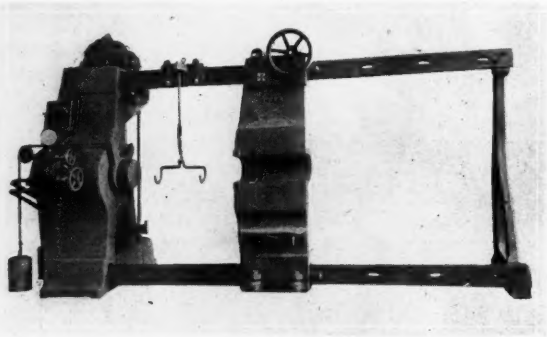


FIG. 3. MOTOR OPERATED HYDRAULIC WHEEL PRESS

yards, coal yards and mines, machine shops, foundries, cement plants, ship yards, dock companies and any other concerns using a considerable amount of machinery or rolling stock.

The motor operated wheel press shown in Fig. 3 is probably the most highly perfected one that has been built, at the same time its manufacturers, E. R. Caldwell & Co., of Bradford, Pa., call attention to its convenience in operation and simplicity of construction. These claims seem to be well subtantiated by an examination of its operation and construction.

For convenience in handling heavy work such as locomotive drivers and irregular shaped work that cannot be rolled to and from the press, the upper horizontal parallel bar is not directly above the lower, but at a slight angle which permits handling the work with an overhead crane.

Plungers, not shown in the illustration, are operated by eccentrics on the back shaft which is driven by cut gears having 3½ to 1 ratio. The plungers operate without vibration and are practically noiseless. The ram is drawn back automatically as soon as the pressure is shut off from the pumps. An extra valve to connect with the city water line is furnished when it is possible to have such connection. By opening this valve, before using the pressure from the pump, the steel faced ram is moved out against the work more rapidly than it could be done by the pumps; the city water line valve is then closed, the pump valve opened and the plungers started.

The press is equipped with low and high pressure pumps. The low pressure pump operates the ram up to a certain pressure with a greater speed than the high pressure pump and consequently increases the amount of work that can be handled by the use of a high pressure pump alone.

This low pressure cylinder is arranged with a relief valve so that pump works until about 50 tons pressure is reached when it automatically cuts out and the pressing operation is continued at a slower rate with the high pressure pumps.

In pressing off work this automatic device is especially efficient. The low pressure pump works until about 50 tons is reached when the high pressure pumps begin to operate, and press until the work is pressed off far enough to enable it to be finished with low pressure and consequently with greater dispatch.

Pump cylinders are cast from a special semi-steel mixture which gives them great strength, and makes them proof against leakage. All presses are provided with a safety valve to prevent overloading. The plungers are driven by a direct current, 7½ hp. motor.

Motor-Operated Draw Bridge

THERE is probably no application where electric drive has so many points of superiority over steam drive as in draw bridges, and especially those cases where swinging is infrequent.

Figure 4 shows a bridge spanning the Sacramento River near Chico, California, which has proved to be

FIG. 4. MOTOR-OPERATED DRAW BRIDGE

an ideal application to show the advantages of motor drive. This bridge swings only a few times a dav. It is, however, able to swing at a moment's notice. The fact that there is no boiler makes it unnecessary to employ the full time of a tender. A person employed at some other work near at hand, after hearing the signal, has ample time to go to the pilot house and swing the bridge by the time the vessel is ready to go through.

Power is used only when the draw is operated, thus the power cost is much less than steam which must be kept available at all times. The motor is back-geared and the countershaft is directly over the motor frame, making it still more economical of space than the usual method of mounting the countershaft at the side of the frame. In the installation there are 2 motors back-geared to the shaft, and so arranged that either or both can be clutched in to operate the bridge. Ordinarily, however, one motor is used to lift the bridge off the piers and the other to swing it. Each of these motors is rated at 20 hp. and operates

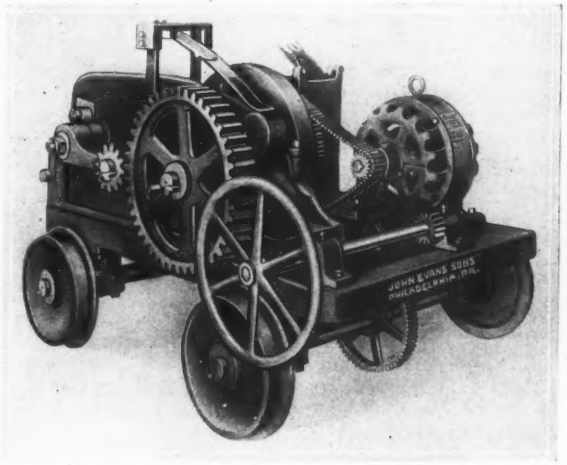


FIG. 2. PORTABLE MOTOR-DRIVEN SHEAR

at 580 r.p.m. They are of the slip-ring type most suitable for this service inasmuch as they can be started with a minimum amount of energy, thus keeping down the peak load.

Besides the main drive motors, there are 2 2-hp. motors for operating the gates. A neat little panel in the pilot house controls the electric installation. Motors used in these installations were manufactured by the Westinghouse Electric & Mfg. Co.

INTERESTING TESTS OF A REINFORCED CONCRETE TANK

TESTS with fire and water were made some time ago of the reinforced concrete tank 5 by 5 ft. in size, with walls 3 in. thick, plastered on No. 24-gauge reinforcing material. The results were reported by Vice-Consul-General D. Milton Figart, Singapore, Straits Settlements, where the tests were made. Tests for deflection were first made with water and then after the tank was dry 160 gal. of kerosene oil was poured into the tank to a depth of about 12 in.

After the oil had been burning 10 min. a 1/16 in. deflection was reported; 45 min. later the deflection was 1/16 in., and an hour later ⅛ in. The heat was instense and drove the spectators back. The deflection increased to 3/16 in. when the tank had been a mass of flames for exactly 2 hr. The oil burned for 3 hr. and when the fire had gone out the deflection recorded was ⅝ in. A few cracks were visible on the outer walls and the plaster had peeled in some places on the inside, but not a drop of oil escaped from the tank. After the fire the tank was filled with cold water and a few slight leaks were discovered, but the tank stood firm and did not collapse as was expected.—Iron Age.

PRACTICAL ELECTRICAL ENGINEERING

Electromagnetic Induction, Its Cause and Effect. The Induction Coil, Its Construction and Operation With Diagram of Connections

ELECTROMAGNETIC induction is the reaction between magnetic lines of force and a conductor forming a closed circuit. In Fig. 1 is shown a solenoid connected to several turns of wire wound about an ordinary compass. If the permanent magnet is inserted in the solenoid, an e.m.f. will be established in the winding and current will flow through the turns of wire surrounding the compass causing its needle to assume a position parallel with the axis of the turns.

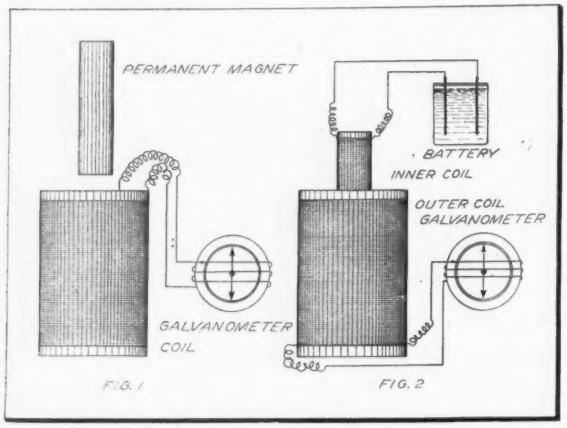


FIG. 1. EXPERIMENT TO DEMONSTRATE ELECTROMAGNETIC INDUCTION FROM A PERMANENT MAGNET

FIG. 2. SOLENOID AND ELECTROMAGNET FOR DEMONSTRATING ELECTROMAGNETIC INDUCTION

As soon as the permanent magnet comes to rest, current will cease to flow, but when the magnet is withdrawn an e.m.f. will again be established, causing current to flow in a direction opposite to that when the permanent magnet was inserted; and the compass needle will again turn, but it, also, will move in a direction opposite to its first movement.

From this phenomena we find that electromagnetic induction is present only when the permanent magnet is in motion or, if it were stationary, the solenoid would have to be moved backward and forward to set up an e.m.f.

If, instead of the permanent, an electromagnet is connected to a battery as shown in Fig. 2, the same effects will be produced as in the experiment described in connection with Fig. 1.

If 2 electromagnets have a common core and are connected as shown in Fig. 3, by pressing the key, current from the battery will flow through one magnet and set up an e.m.f. in the second coil as will be shown by the action of the compass needle. This induced current is but momentary, as it ceases when the lines of force gain equilibrium and the amount of magnetism becomes constant.

When the key is opened, an e.m.f. will again be induced in the coil but it will be in a direction opposite to that when the circuit was closed. It is evident from this experiment that a circuit through which current is flowing is capable of setting up an induced e.m.f. when the current changes, by the rise and fall in the intensity of the magnetic lines of force threading a coil.

Induction coils used for wireless telegraphy, X-Ray work and medical purposes act upon the principle of electromagnetic induction. A simple induction coil is shown in Fig. 4. It consists essentially of a spool formed of an iron core, made up of small iron wires, with fiber washers on each end. There are 2 separate and distinct windings on the spool as shown in Fig. 5. The first, or inner coil, consists of a few turns of coarse wire which are connected to the battery through an interrupter consisting of an iron armature on a fixed spring which tends to hold the contacts together and leave a small space between the armature and core.

When current flows through the inner coil, called the primary coil, the armature is drawn toward the core and the circuit is interrupted at the contacts; the core loses its magnetism and the spring closes the circuit. This action is repeated a great many times a second causing rapid vibration of the interrupter.

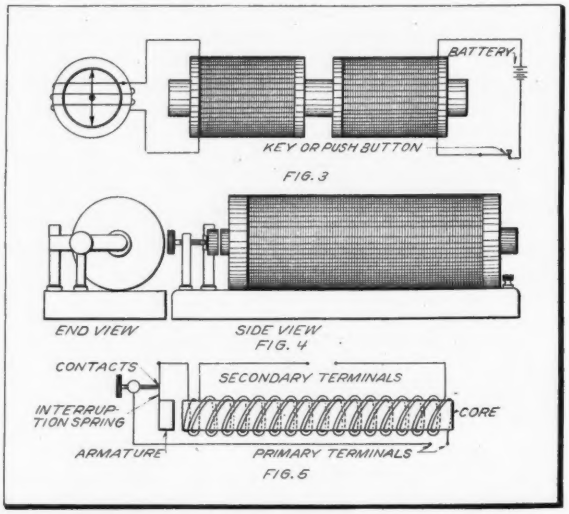


FIG. 3. TWO ELECTROMAGNETS ON A COMMON CORE FOR DEMONSTRATING ELECTROMAGNETIC INDUCTION

FIG. 4. ELEVATION OF A SIMPLE INDUCTION COIL

FIG. 5. CONNECTION AND WINDING DIAGRAM OF AN INDUCTION COIL

At each make and break of the primary circuit an e.m.f. is induced in the outer coil called the secondary winding, which is composed of a large number of turns of fine wire. The e.m.f. reverses with the make and break as explained in connection with Fig. 3 and acts through the secondary circuit first in one direction then in the opposite direction, producing an alternating current of high voltage.

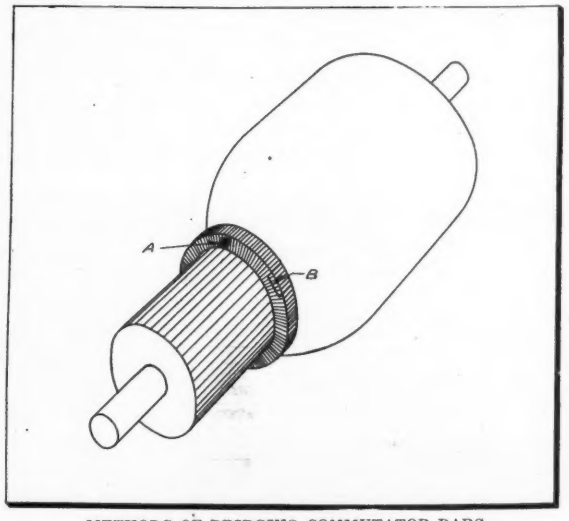
CARBON DEPOSITS IN THE COMBUSTION spaces of a motor may not always make its presence felt by reason of loss of power and knocks. On the contrary, the symptom may be an increase of power and accelerative properties, the reason being that the combustion space is slightly decreased in volume, causing higher compression and, within certain limits, greater power. As a general rule, such symptoms may be taken to mean that a small accumulation of carbon exists and care should be taken to remove it. If it is not removed, it will increase rapidly and the symptoms will change to knocks and serious loss of power.—Gas Power.

BRIDGING COMMUTATOR BARS

Methods Employed to Make Temporary Repairs

IT frequently occurs that an armature coil will burn out or a lead break. Temporary repairs can be made by means of a jumper.

If the coil is burned out the best thing to do is to break the connection between the end of the coil and one of the commutator bars, turn up this broken end



METHODS OF BRIDGING COMMUTATOR BARS

and tape it and then connect the bar to which this end was attached to one or the other of the adjacent bars, it makes no particular difference which. This can be done either by a drop of solder bridging the insulation, as shown at A, or by soldering a piece of wire across the insulation on the tails of the commutator bars, as shown at B.

REPAIRING A COMMUTATOR

By C. V. Glynn

AS to mending a commutator, remove all dirt and dust from the cavity in the commutator, fill with a mixture of shellac and plaster of Paris, allow an hour or 2 to dry. This method has been used by the writer in making temporary repairs to commutators on both 250 and 600-volt service.

There is also a preparation known as Plaster Mica or Soluble Mica Commutator Insulation made by The Plas-Mica Co., Yonkers, N. Y.

NEW RECEPTACLE

Water Tight Construction Adapting it to a Wide Variety of Service.

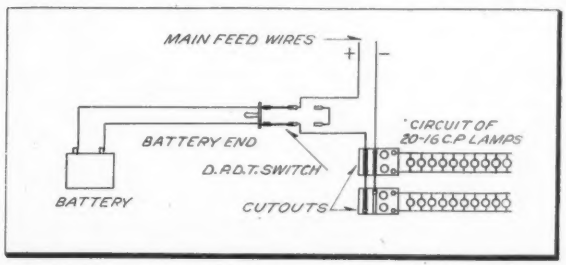
AN electric receptacle closed water tight by a valve has been introduced by the Conlan Electric Co., of New York, the valve being employed in place of the portable cover to close the opening disclosed by the removal of the plug. The closing action of the valve and valve spring is also used to make a quick break of the electrical connections when the plug is withdrawn. Another strong feature is in the cam means of connecting the plug to the box, which compresses a gasket, carried by the plug, on the face of the box, making a watertight joint. The operator, therefore, is required only to make and break the electrical connections as the box is made watertight automatically. The United States Army has adopted the device exclusively and it is also used on United States battleships and in any place where water is liable to penetrate.

CHARGING A SMALL STORAGE BATTERY

Simple Method Utilizing Lighting Circuits

By John D. Henderson

HOW to make a suitable resistance to use when charging a small storage battery, was a question that bothered me. I did not like the idea of making a special rheostat of a lamp bank as there is so much current wasted with such. The illustration shows the way in which I have arranged our lighting circuits in the engine and boiler room to charge a battery. The batteries which I had to charge were rated at 6 volts and charged at a 5-ampere rate from our 220-volt lighting circuit. Connect the positive wire of the circuit to binding post of the battery marked positive and the negative wire to the negative post as shown in sketch. Throw switch to left in the position marked battery and connect the lamps for the required current. On a 220 volt circuit one 16 c.p. carbon lamp consumes approximately 0.25 and a 32 c.p. lamp approrimately 0.5 ampere. If there are not enough 16 c.p. lamps in the circuit they may



CONNECTIONS FOR CHARGING A SMALL STORAGE BATTERY

be replaced with 32 c.p. lamps which will double the current. There is one objection to this way of charging, it dims the lights a little. A 6-volt battery reduces the voltage on the lights to 214 volts or a difference of 6 volts.

CORRECTION NOTE

IN the issue of September 1st, on page 881, an error occurred in the preparation of the manuscript by Mr. Converse in regard to the properties of hydrogen. The second paragraph should refer to Oxygen as being colorless, odorless, tasteless, not at all inflammable, but a strong supporter of combustion. A previous paragraph should have read, "Hydrogen when pure is colorless, odorless and tasteless gas, strongly inflammable but in no way a supporter of combustion."

TO-DAY IS HERE for all who choose to use it. Tomorrow is the day when idlers work and fools reform and mortal men lay hold on heaven.—Triumph Chronicle.

LET US HAVE "pure dry goods" as well as "pure food." The poor unjustly blamed power laundryman will say amen to that proposition.—Laundryman's Guide.

PRACTICAL MATHEMATICS

Everyday Problems Solved by Percentage

ALL examples in percentage involve but one principle, and that is, calculating by hundredths. A certain percent of a number is the number of hundredths of that number which is indicated by the number of units in the percent.

For example 6 percent of 110 is $110 \times \frac{6}{100} = 6.6$.

4 percent of $100 = 100 \times \frac{4}{100} = 4$.

There are 3 principal elements entering into percentage calculations: The base, or number on which the rate is computed; the rate, or number of hundredths of the base to be taken, and the percentage, which is the part or number of hundredths of the base indicated by the rate.

All calculations in percentage are based on the rule: Percentage = Base × Rate, which should be thoroughly impressed upon the mind, as all other rules used in percentage are derived from this rule.

The sign of percent is %, read percent, and always indicates hundredths or 2 decimal places in the number which it follows, thus instead of expressing 6 percent $\frac{6}{100}$ we use 0.06 or 6%.

What is 6% interest charge on a motor worth $260? Percentage=base×rate; 260. × 0.06 =15.6.

Table 1 shows percentage equivalents in decimals and fractions.

An engine of 300 indicated horsepower has a mechanical efficiency of 75%. What power is available at the flywheel?

Mechanical efficiency is the ratio of developed power to indicated power, so that the developed or available power is 75% of the indicated. Then by the hp.rule, Percentage=Base×Rate, we have Developed hp.=300×0.75=250 hp.

Let us state a problem differently; if out of a stock of 1000 2½-in. boiler tubes, 160 were used in the construction of a boiler, what percent of the 1000 tubes did the boiled contain?

Here we are given the base 1000 and the percentage 160 to find the rate. By the rules of percentage, Rate=Percentage÷Base; 160÷1000=0.16 or 16% Ans. This formula, as well as all others, is derived from the first formula, Percentage=Base×Rate by the process of dividing both sides of the equality by the same quantity.

During a 6-hr. test of a boiler, 3162 lb. of coal were used; the weight of the ash was 63 lb. What was the percent of ash?

63 ÷ 3162 = 0.019 or 1.9%. Ans.

Again changing the statement of the second problem: If 160 2½-in. tubes were used in the construction of the boiler and this number is 16% of the total number of 2½-in. tubes in stock, how many tubes were there originally? Here we were given the percentage and rate to find the base. Base=Percentage÷Rate; 160 ÷ 0.16 = 1000 tubes. Ans.

Efficiency is defined in engineering as the quotient of output divided by input, that is, the energy utilized divided by the energy expended. The difference between them is the energy lost or wasted.

During an efficiency test of an electric motor in which a Prony brake was used, the motor developed 18.5 hp. at the pulley; the input in electrical horsepower was 23.5. What was the per cent efficiency of the motor at the given load?

$$\text{Efficiency} = \frac{\text{output}}{\text{input}} = \frac{18.5}{23.5} = 0.78 \text{ or } 78\ \%$$

Ans.

A carload of coal was purchased for $140 and was sold 2 days later at an amount 8% over the purchase price. What was the sale price? The base $140, and rate, 8%, are given and we wish to find the amount or sale price.

Per Cent.	Decimal	Fraction	Per Cent	Decimal	Fraction
¼	.0025	$\frac{¼}{100} = \frac{1}{400}$	15	0.15	$\frac{15}{100} = \frac{3}{20}$
½	.0050	$\frac{½}{100} = \frac{1}{200}$	16⅔	.16⅔	$\frac{16⅔}{100} = \frac{1}{6}$
¾	.0075	$\frac{¾}{100} = \frac{3}{400}$	20	0.20	$\frac{20}{100} = \frac{1}{5}$
1	0.01	$\frac{1}{100}$	25	0.25	$\frac{25}{100} = ¼$
1½	.015	$\frac{1½}{100} = \frac{3}{200}$	50	0.50	$\frac{50}{100} = ½$
2	0.02	$\frac{2}{100}$	62½	.625	$\frac{62½}{100} = ⅝$
3	0.03	$\frac{3}{100}$	75	0.75	$\frac{75}{100} = ¾$
4	0.04	$\frac{4}{100}$	100	1.00	$\frac{100}{100} = 1$
5	0.05	$\frac{5}{100}$	125	1.25	$\frac{125}{100} = 1¼$
8⅓	.08⅓	$\frac{8⅓}{100} = \frac{1}{12}$	150	1.50	$\frac{150}{100} = 1½$
10	0.10	$\frac{10}{100} = \frac{1}{10}$	200	2.00	$\frac{200}{100} = 2$
12½	.125	$\frac{12½}{100} = ⅛$	500	5.00	$\frac{500}{100} = 5$

PERCENTAGE EQUIVALENTS IN DECIMALS AND FRACTIONS

We can, therefore, find it by calculating the percentage and adding it to the base or, since the base is 100 per cent or 1.00 we may add the rate to 1.00 and multiply the base by that sum. In the first method, 140 × .08 = $11.20; 140 + 11.20 = $151.20. In the second method, 1.00 + 0.08 = 1.08; 140 × 1.08 = $151.20.

Again, if the coal was bought for $140 and sold at an 8% loss, at what price did the coal sell?

In this problem we have to find the percentage and subtract from the base, or we can multiply the base by 1.00 minus the rate. By the latter method, 140.00 × ($1.00 — 0.08) = $140 × 0.92 = $128.80.

Again, if the carload of coal was sold for $151.20, and this represented a profit of 8% over the purchase price, what was the original price of the coal?

A profit of 8% means a gain of $8 on every $100 expended. If an article is bought for $1 and sold for $2 the profit is 100 per cent, but if bought for $2 and sold for $1 the loss is not 100 per cent (as that would be a total loss), but 50 per cent.

Here the rate of the amount or selling price = 1.00% + the rate of profit, and to find the base we divide the amount by its rate: (1.00 + .08) = 1.08. $151.20 ÷ 1.08 = $140. Ans.

If in the previous example the coal had been sold for $128.80 and there was an 8% loss by the transaction, how much did the coal cost? The rate of the remainder is 1.00 — the rate of loss, or 1.00 — 0.08 = 0.92; $128.80 ÷ 0.92 = $140. Ans.

The rules of percentage may be summarized as follows:

Percentage = base × rate, from which are derived:
Base = percentage ÷ rate.
Rate = percentage ÷ base.
Amount = base × (1 + rate).
Remainder = base × (1 — rate).
Base = amount ÷ (1 + rate).
Base = remainder ÷ (1 — rate).

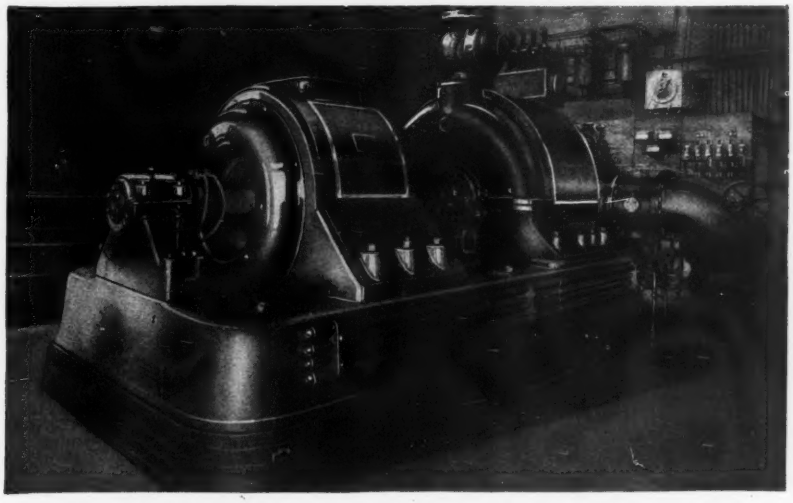
WASTE STEAM DRIVES MOTORS

Installation of Mixed Pressure Turbine Using Exhaust Steam Saves Power Bill

IN the plant of the Indiana Steel & Wire Co., Muncie Ind., 2 22 by 42 in. Bates Corliss noncondensing engines operate a series of wire drawing benches. These engines receive steam at a pressure of 100 lb. from a battery of boilers consisting of 4 150-hp. and 3 125-hp. units. Each engine carries a load averaging 370 to 400 hp. and operates continuously with the exception of Sundays and holidays. Sixty-cycle, 220-volt motors, are employed to drive the machines which fabricate the wire into wire fencing, wirenails, etc. The electric power for the operation of these motors was formerly purchased from an outside source but, in the early part of 1910, it was decided to utilize the exhaust steam from the Corliss engine to generate this electric power and save the constant expense of purchased power.

Accordingly a 600-kw. mixed pressure Curtis turbine was installed and the exhausts of the 2 Corliss engines conducted to a common header from which the turbine derives its steam at a pressure of 1 lb. gage. The turbine exhausts into a Wheeler Condenser & Engineering Company's condenser which maintains a vacuum of 28 in.

In case the engines are shut down, the mixed pressure turbine is not affected, as it automatically cuts in sufficient high pressure steam to meet its power requirements. The turbine now carries the entire motor load of 600-hp. using steam that was formerly allowed to go to waste, and this economy has been effected without increasing the size of the engine room, the number of boilers, or the number of operators about the plant.



MIXED PRESSURE TURBINE IN PLANT OF INDIANA STEEL AND WIRE CO.

ELECTRIC SHIP PROPULSION

ELECTRIC ship propulsion recently received its first trial; on Aug. 24 the naval fuel ship "Jupiter," equipped for such driving, was launched at the Mare Island Navy Yard. The new system is being given a good trial, for this ship is 572 ft. long, 65 ft. beam, draws 27½ ft. loaded and will carry 12,500 tons of coal and 375,000 gal. of fuel oil. Her object, aside from her duty as a fuel carrier, is to demonstrate that economies in fuel consumption on turbine ships can be obtained by using turbo-generators furnishing current to motors on the propeller shafts, instead of connecting the turbines directly to the shafts. In the latter combination the efficient speed of the turbine and of the propeller are not the same, and a compromise has been made by raising the propeller speed and decreasing that of the turbine. The propeller is not so efficient as at a lower speed, and the weight of the turbines has been greatly increased. By using an electric drive the turbine can be kept down to the dimensions and up to the speed of stationary practice; by using two motors on each shaft all the requirements for propeller efficiency at any speed, ahead or astern, can be readily met.

According to figures, the total efficiency in pounds of steam per horsepower on the shaft would be substantially constant at speeds ranging from 12 to 21 knots, and far better than ordinary turbine propulsion could show. The total weight of the mechanical equipment of the ship was not lowered by this system of propulsion.—Engineering Record.

THE ONE who never fails is the one who never tries. —Triumph Chronicle.

MENSURATION

Areas and Circumferences of Circles, Areas of Circular Rings, Volume of Rectangular and Round Rings

FIGURING these values is simple, but it is so frequently called for that familiarity, quickness and short cuts are desirable. For usual values the tables of circumferences and areas given in the Practical Reference Tables of this and former issues are the best and most convenient method, but sometimes diameters not given in the tables are wanted, and sometimes the tables are not at hand when the figuring is to be done.

In passing, a word as to extending the use of the tables. These run from 1/64 up to 100 and of course may be used for inches, feet, yards or miles, the circumference and area being in the same units in which the diameter is taken. If it is desired to go above 100, it may be done by remembering that the circumference increases in proportion to the diameter, and the area increases in proportion to the diameter squared; i.e., for diameter 200, the circumference is 10 times that for 20, and the area 100 times that for 20.

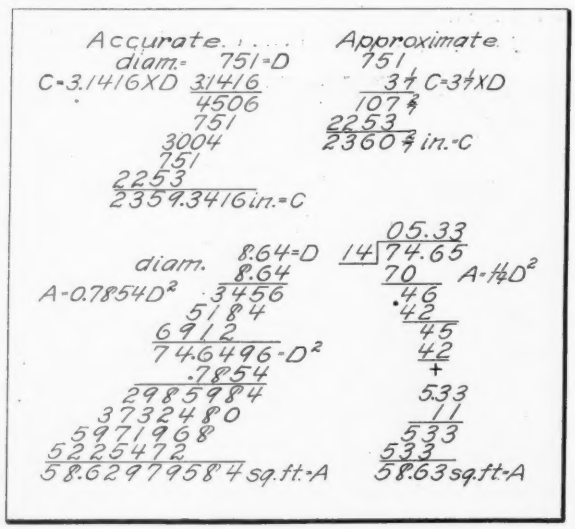


FIG. 1. EXACT AND APPROXIMATE CALCULATION OF CIRCUMFERENCE AND AREA

If the circumference of a wheel 751 inches in diameter is wanted, look up the value corresponding to 75.1, 235.9 and multiply by 10, giving 2359 in. Or if the area of a boiler head 8.64 ft. diameter is wanted, look up the value corresponding to 86.4, 5863, and divide by 100, giving 58.63 sq. ft. In like manner any values may be found, but for large diameter, having 4 or more figures, there will be considerable inaccuracy in the result.

For the circumference, multiply the diameter by 3.1416, or for approximate calculations by 3 1/7; and for the area, multiply the diameter squared by 3.1416 ÷ 4, which is 0.7854, or for approximate figuring, multiply the diameter squared by 11/14. The figures for the examples of the last paragraph are shown in Fig. 1, the exact values at the left and approximate values at the right.

To perform these operations on the slide rule, for the first, place 1 on the B scale at 3.1416 on the A scale. This value is usually indicated by a special line marked π. Bring the runner to 751 on B, and on A under the runner find 2359. As $3 \times 700 = 2100$, it is evident that the answer is a whole number.

For the second problem, we use both upper and lower scales as a square is involved. Set 1 on B (right hand end) at 0.7854 on A, which is specially marked by a long graduation. Bring the runner to 864 on C. This sets it over 864 squared on B or 746; compare this with the figures of Fig. 1. Then on A, under the runner, read 5865, which as $8 \times 8 = 64$, and $65 \times 0.7 = 4.5$ must be 58.65 sq. ft.

Area of Flat Ring

SUPPOSE that the area of cross-section of a hollow staybolt is wanted, outside diameter 1 in., inside diameter ¼ in. Evidently this is the area of the larger

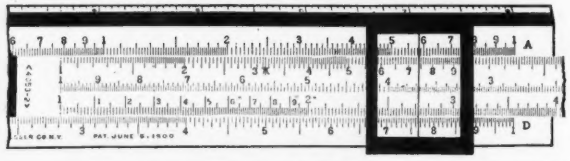


FIG. 2. SLIDE RULE SETTING FOR FIGURING AREA OF CIRCLE WHOSE DIAMETER IS 8.64

circle minus that of the smaller. For the larger, 1 squared equals 1, which times $0.7854 = 0.7854$ sq. in. area. For the smaller, ¼ squared = 1/16, which times $0.7854 = 0.049$. The difference is $1 - 0.049 = 0.951$ sq. in.

In making a slide rule computation, it is easiest to follow the process outlined above, but in arithmetical figuring one multiplcation may be saved. Both 1 and 1/16 were multiplied by 0.7854 and the difference of the products taken; the result is the same if the difference is taken before multiplying. Thus $1 - 1/6 = 15/16$, and $15/16 \times 0.7854 = 0.951$.

If the radius is given, instead of the diameter, the radius squared is multiplied by 3.1416 to get the area of a circle. Thus for a chimney having outside radius 6 ft. and wall 2.5 ft. thick, what area will carry the

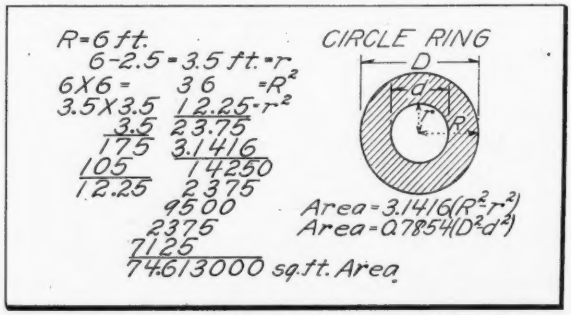


FIG. 3. DIAGRAM AND FORMULAS FOR RING AREA, AND SOLUTION OF PROBLEM

weight of the chimney? Fig. 3 shows the rules for areas, expressed as formulas, and the work of the problem.

For a ring of rectangular section, the volume is the area of one side times the thickness. From the fore-

going and Fig. 3, the area of the side is 3.1416 ($R^2 - r^2$) and this times the thickness, W, Fig. 4, gives the volume.

For a collar on a 4-in. shaft the outside diameter is 6 in. and thickness ¾ in. At 0.28 lb. per cubic inch, what will the collar weigh?

The work is shown in Fig. 4.

Another way of looking at this is to multiply the sectional area by the mean circumference. The sectional

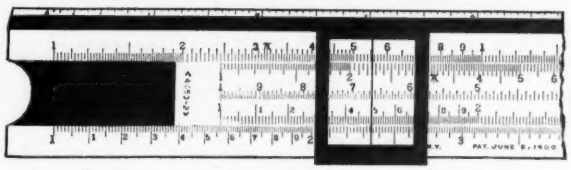


FIG. 6. SLIDE RULE SETTING TO MULTIPLY 2467 BY 15²

area is W (R — r). The mean radius is (R + r) ÷ 2, and the mean circumference is 3.1416 times mean radius × 2, or $\frac{(R+r)}{2} \times 3.1416 \times 2$, which reduces to 3.1416 (R + r). This gives for the volume, W (R — r) × 3.1416 (R + r) or rearranging, 3.1416 W (R — r) (R + r). In the figure, it is shown that for the problem given the value of ($R^2 - r^2$) is equal to the value of (R — r) (R + r), which is simply one example of the general rule that if the sum of 2 quantities be multiplied by their difference, the product will equal the difference between the squares of the quantities. The volume works out the same, of course, by both methods.

For a ring of round section, the last method is used, but the dimensions given are usually the diameter of the iron from which the ring is made and the mean

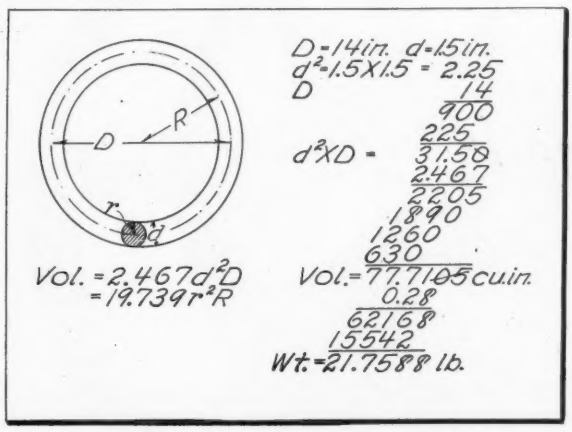


FIG. 5. VOLUME AND WEIGHT OF ANCHOR RING

diameter of the ring. The sectional area will then be 0.7854 times the diameter of the iron, or 0.7854d^2; the mean circumference will be 3.1416 times the mean diameter, or 3.1416D; the volume will be the product of these, or 0.7854 × 3.1416d^2 = 2.467d^2D. If the radius be given in each case, the rule for volume will be 19.739r^2R.

For an anchor ring 14 in. diameter of 1½-in. round iron, what weight of iron will be used? The arithmetical work is shown in Fig. 5.

To use the slide rule for this problem, set 1 at the left hand end of B at 2467 on A; bring the runner to 15 on C, which will give 15² on B, and bring 1 on B to the runner; bring the runner to 14 on B, and 1 on B

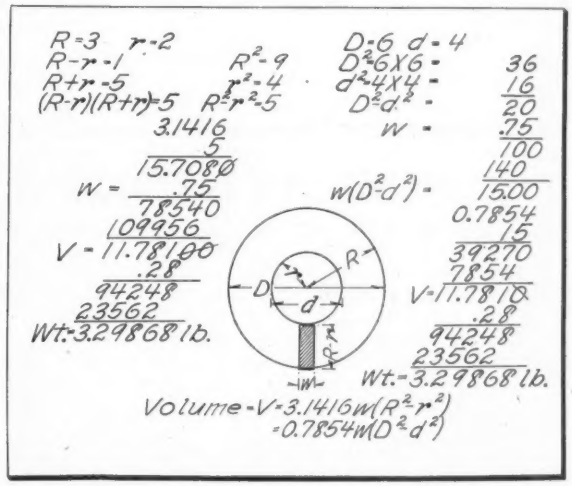


FIG. 4. FINDING VOLUME OF RECTANGULAR RING AND ITS WEIGHT

to the runner; bring the runner to 28 on B, and on A under the runner find 2175. The approximate calculation to get the decimal point is 1 × 2 × 15 × 2 × 0.3 = 18; hence, the answer is 21.75 lb.

DISTILLATION OF COAL

At the present time various gas-supply works use a large quantity of oil in the production of gas, in addition to distilling coal for the purpose, and if deliveries of the former were available to a greater extent, it is probable that an impetus would be imparted to this particular branch. What may be accomplished in the British coalfields in the production of oil from coal remains to be seen, but it is noteworthy that a process has already been adopted at large collieries in Nova Scotia for the manufacture of oil, and sulphate of ammonia and coke, and the owners are prepared to supply either coal or oil for use in the London gasworks in the near future. The coal, it is said, would be delivered in the Thames at a price that is considerably under the normal quotation paid in London, whilst the rate for the oil is not mentioned.

It is not our place to predict what the result of this offer may be. What we would point out is that public-utility undertakings such as gasworks must of necessity be very largely dependent upon native resources of raw materials in order to ensure continuity in the supply of light, as no interruptions in transmarine deliveries would be tolerated in this respect. Not only so, but it is unlikely that Canadian coal in practice could actually be landed in the Thames at a lower rate than coal from the British coalfields.

Although British coal is comparatively dear at present, and may become more costly in the near future, owing to legislative measures, the hope certainly exists that it will become cheaper in the course of a few years in view of the gradual extension in the use of coal-cutting machinery and conveyers at the working face. The year 1911 is the first to inaugurate an improvement in the average output per miner in consequence of the increased use of such machinery.

GAS POWER APPARATUS

Producers, Engines and Industrial Applications

SIXTY-FIVE HORSEPOWER OIL ENGINE

Using Kerosene Oil by Cold Carburetion. Rolling Lift Valves and Throttling Governor Control

IN the Adams Kerosene Gas Engine, there has been designed a successful prime mover which uses power kerosene, gas oil or power distillate in a cold carbureter gasifying exactly as gasoline is gasified, and which runs as steadily and governs more closely than the more common form of combustion engines on which we have come to rely implicitly. It gives the impression as one examines it that it has been carefully designed throughout, not only as to general principles and arrangement, but in all details.

General Arrangement

THIS engine is of the 4-stroke cycle type, single acting, with long piston and crosshead pin mounted in the center so that it gets steady bearing. All valves are in the head, and all parts of the valve motion except the lay shaft are carried on the head casting. The valves are of mushroom shape, positively opened by a rolling lift motion and closed by a spring. Governing is by means of throttling the intake of both air and fuel mixture the position of the governor valve being controlled by a flyball mechanism driven from the lay shaft. The engine is started by compressed air, followed up if need be by a few shots of gasoline, the air supply being furnished from a reservoir which is charged while the engine is running. The head is made hemispherical on the inside with all valves even with the surface so that there are no pockets to hold hot gases and cause premature ignition.

The Frame

MADE in a single massive casting, the frame carries the main bearings, the cylinder and the lay shaft bearings. It is closed at the bottom and thus forms a receiver for the used oil, which can be filtered and reused as often as desired.

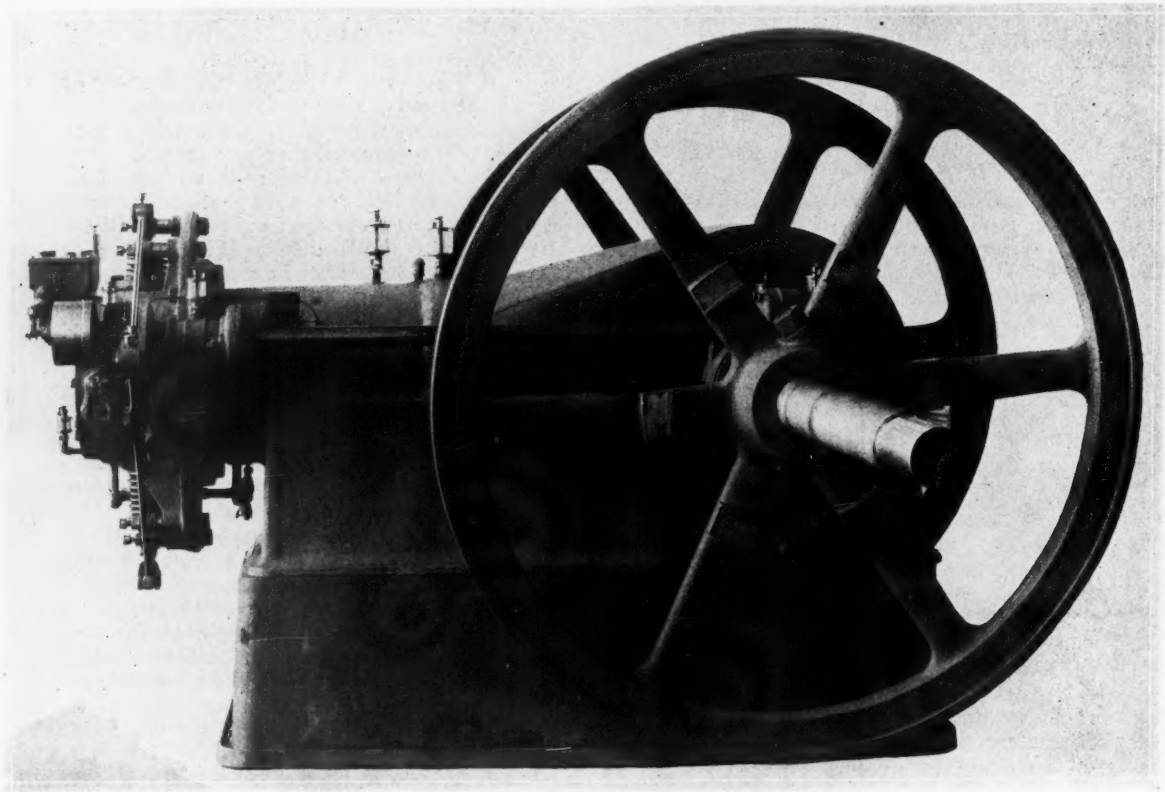


FIG. 1. ADAMS-WISCONSIN OIL ENGINE, VALVE GEAR SIDE

At the forward end are carried the main bearings which consist of babbitt shells in halves, the up-

per one being held in place by a cap with 4 holding down bolts, and adjusted for wear by shims. At the cylinder end, there is a slight overhang to permit the head and the valve motion to clear the frame, but the weight of the piston, the pressed in liner and the cylinder water jacket are practically all carried above the base of the frame. The liner and piston are of semi-steel so that there is practically no wear, the liner being held in place by the head so that it cannot work loose while running.

Reciprocating Parts

BEGINNING at the piston end of the chain of parts which transmit the power, the piston is a single casting with spherical shaped end, conforming to the shape of the cylinder head. It has bronze bushings in which the crosshead pin swings and on the head end is fitted with 5 snap rings carefully fitted into turned grooves. The piston pin is clamped in the split end of the connecting rod by means of a bolt fitted with lock nut, and can thus be revolved to correct for wear. At the crank end, the connecting rod is of marine type, fitted with babbit shells, and adjusted for wear by shims fitted between the halves of the bearing. Big surface for bearing and wear is the special characteristic at all points. The crankpin which is a part of the heavy shaft is much larger than is usual for an engine of the size illustrated, 65 hp. The shaft bearings are 6½ in. diameter and 12 in. long, and other parts in proportion.

Crankpin, crank arms and connecting rod end are counterbalanced by weights bolted to the ends of the crank webs, and notched over these webs to prevent side movement. Flywheels are overhung at each side of the frame, and each is provided with bosses on the arms by which pulleys may be fastened for belt driving, or the shaft may be extended for direct mounting of a generator armature. The wheels are made fast to the shaft by means of a split hub and key.

Valve Gear

DRIVEN by heavy spiral gears from the main shaft, a lay shaft extends along the side of the engine to the cylinder head where it drives the high tension magneto, the flyball governor, and carries on the end the cam which controls the admission of air for starting and the crank which drives the silent operating rolling and multiplying levers of the admission and exhaust valves. As seen in the view of the head, the valves are driven through positive connections to the levers for operating the valves. There is an easy rolling motion between those surfaces which carry the push of the valve spring, similar to that of the valves of marine engines of the older slow speed type, giving easy action and practically no wear. The valves are set once for all in the design of the engine, and no attention is needed other than to keep the bearings lubricated.

The exhaust valves are mounted on a seat directly in the head, but the admission valve is carried in a bonnet which is bolted into the top of the cylinder head casting. On the end of the valve stem is a casting which serves to take the bearing of the spring and also of the push lever which opens the valve; and this plate may also be used to adjust the strength of the spring.

Ignition

A DRAG crank attached to the valve gear crank pin operates the make and break igniter, current coming from the magneto already mentioned. The adjustment of the time of spark is secured by moving a cam on the end of the ignition lever thus changing the time of tripping the break action, this cam being controlled by a hand lever on the bracket which carries the motion, and may be adjusted while the engine is running.

Carbureter

COLD carburetion is used under the Secor-Higgins system, a spray of oil being drawn from a feed tube by the suction of the passing current of air, which also draws a mist of water to mix with the fuel mixture to assist in cooling the cylinder. In the carbureter are 2 compartments, one for oil, the other for water. From each compartment a pipe leads downward with the opening into it a little above the level at which the liquid is maintained. On the end of each pipe is a tee with holes drilled in the

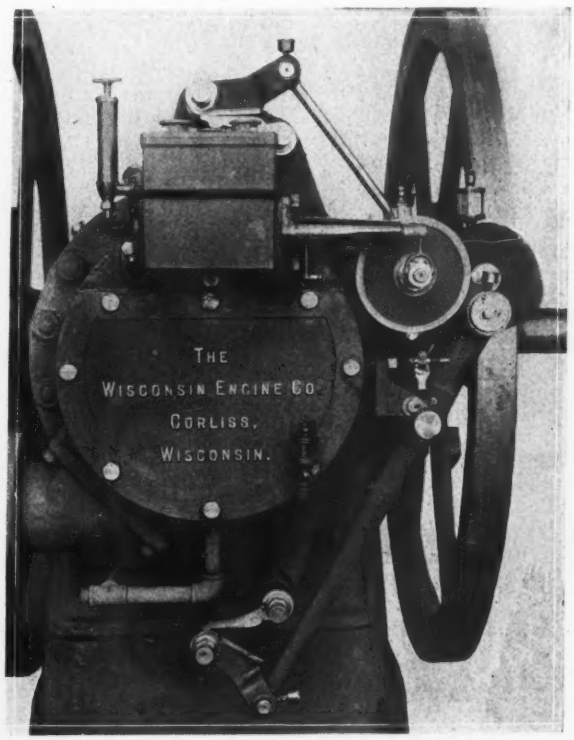


FIG. 2. END VIEW OF VALVE GEAR SHOWING CAMS AND ROLLING LIFT GEARS

bottom, the air as it is sucked in by the engine, passing across these holes draws a little of the liquid over into the feed pipes at each stroke.

The liquid level in the compartments is maintained by means of an overflow pipe, the oil being furnished by an oil pump driven from the admission valve lever, and the water being taken from the water jacket of the head. Unused water overflows to the jacket waste, and oil to the supply tank. A third compartment is provided in the carbureter to hold a small supply of gasoline which is used only in starting the engine. This amount used is so small that the compartment is filled by means of a hand pump.

Air is drawn in through ports at the side of the carbureter, and the opening of these ports is controlled by a rotating valve, much like a Corliss engine valve, and operated by links connecting to the governor. On the other side of the carbureter is the

fuel mixture port to the engine, and the governor valve also has a cutoff edge which controls the opening of this port. A constant mixture of oil vapor, water vapor and air is thus secured, the amount supplied being controlled by the throttling. The supply of oil and water through the feed pipes is regulated by needle valves operated by the milled head screws on top of the carbureter.

Cooling

CYLINDER and head are cooled by forced water circulation, the supply being from separate branches from a common main pipe. The water enters at the bottom and leaves at the top, that passing through the head serving also to cool the valves. Any system for cooling the water and reusing may, of course, be adopted by providing the proper cooling devices and pump for circulating.

Lubrication

FOR all bearings, sight feed oil cups are provided, and for all bearings on the valve motion, grease cups. All oil flows to the bottom of the frame from which it is drawn to be filtered. For the crank pin, there is a ring feed carried on the web to the crank

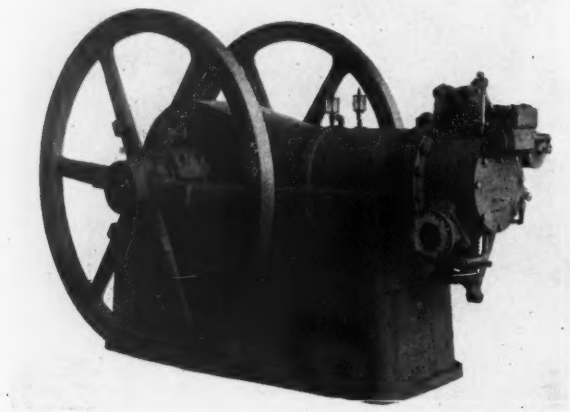


FIG. 3. EXHAUST SIDE OF ADAMS-WISCONSIN OIL ENGINE

and feeding oil by centrifugal force to the pin. For the piston pin bearings, a trough is fastened to the inside of the piston opposite each end of the pin, and into this trough is a tube leading to the pin bearing, so that the pin has constant and abundant oil supply.

Air for starting is controlled by an admission valve driven from the face of the cam which carries the valve crank pin. The stop valve is in the pipe outside this control valve, and the air pressure when turned on forces the admission valve closed except when it is opened by the cam at the proper point to supply the piston on its forward stroke.

Economy

IN a modern prime mover it is not only important that it should run and supply power, but that it shall be an economical source of power. The manufacturers of the Adams Kerosene Gas Engine, The Wisconsin Engine Co., of Corliss, Wis., have had this point in view, and have designed and perfected an engine which they can guarantee to give as much power from a gallon of kerosene as is obtained from a gallon of gasoline used in the ordinary gasoline engine. When the prices of the 2 fuels are compared, it is seen that this gives a big margin in favor of the kerosene gas engine so far as its fuel cost is concerned, and the method employed for cold carburetion and control of the supply gives this gas engine the simplicity which has made the gasoline engine so great for small powers.

The guarantee is that at best load the engine will deliver 11 brake horsepower-hours per gallon of fuel, and that at any load from 1/3 to full it will deliver not less than 10 brake horsepower-hours per gallon. Regulation is within 1½ per cent, and combustion is complete at all loads so that the cylinder will be clean and without any carbon deposits and the exhaust smokeless at all times.

WATER IN THE COMBUSTION CHAMBER OF OIL ENGINES

THAT a 25 per cent increase of power can be obtained by the proper use of water in the combustion chamber of an oil engine without increase of fuel consumption, is the statement made by Mr. Wolcott Remington, the designer of the Blanchard oil engine, who has supported this statement by actual brake tests.

By the use of the proper amount of water 4 distinct benefits are secured: 1. The water prevents the overheating of the cylinder head and piston under very heavy loads; 2. A part of the water clings to the walls of the cylinder, preventing the burning of the lubricating oil; 3. The water on the cylinder walls also decreases the loss of heat to the water jackets; 4. The water vapor in the combustion chamber increases the power and economy of the engine by the following chemical action:

When oil is converted into gas by the action of heat the oil "cracks" and a small amount of carbon is set free in solid form. The water vapor is dissociated into oxygen and hydrogen by the heat of combustion. The nascent oxygen resulting combines with the greater part of this free carbon. If it were not for the presence of the nascent oxygen the free carbon would be deposited on the cylinder walls or in the head of the engine. During the latter part of the expansion of the gases in the cylinder their temperature is reduced so that the free hydrogen unites with some of the free oxygen in the cylinder and adds to the power delivered. The dissociation of the water vapor in the early part of the working stroke prevents the temperature and pressure of the charge from becoming excessive.

In order to secure the best results from using water in the combustion chamber, it is necessary that the supply of water bear a certain proportion to the fuel supply. As the quantity of fuel is changed automatically by the governor in accordance with the load, the quantity of water should be changed at the same time. In the Blanchard oil engine this water supply is cared for by an individual pump for each cylinder. This pump can be set while in operation, if desired, to deliver the correct proportion of water and oil for best results. This ratio, as adjusted, is held constant by the governor at all loads.

BACKBONE, SAND, GRIT, nerve, courage, perseverance, initiative—just keep a stock of these on hand and you'll be taken care of before Mr. Gabriel plays his much-heralded and oft-advertised solo.—Character.

THE GAS TURBINE

Translated From Le Gaz, June, 1912

By J. H. Blakey

PRODUCTION of mechanical energy by means of thermal motors has made such progress in the last few years that it will no doubt be interesting to review briefly the investigations that have been made on a new type of thermal motor, for and against which much has been said, the gas turbine.

This is to the explosive mixture motor what the steam turbine is to the steam engine; but its study is much less advanced and its practical realization is not yet accomplished. It is not, however, a novelty, as it has for 20 yr. past helped to swell the literature of the patent offices, both in this country and abroad.

One can conceive of turbines of direct action and of reaction; in a general way, however, gas turbines are always direct-acting, in which the gas is expanded in the tuyere before coming into contact with the vanes of the motor wheel. It reacts, consequently, upon itself when it has attained its highest speed, just as does the water in a hydraulic turbine.

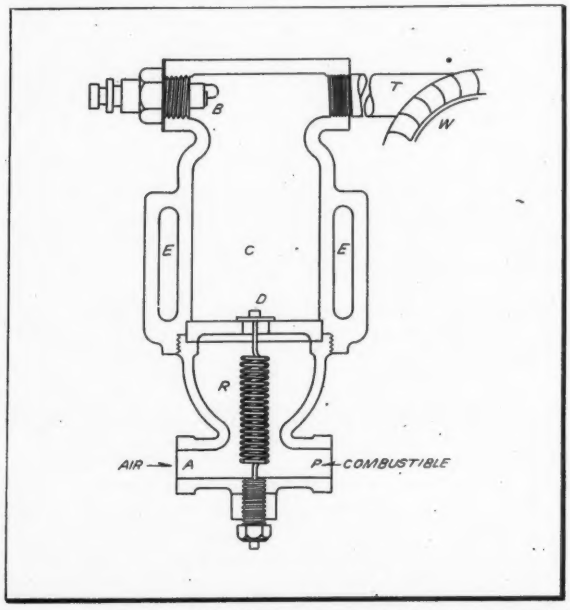


FIG. 1. COMBUSTION CHAMBER OF THE HARADOVINE TURBINE

In a general way, a gas turbine consists essentially of 3 parts: (1) A combustion chamber; (2) a tuyere for the expansion of the burnt gases; (3) a turbine, properly so called, upon which the force of the expanded gases is received.

It comprises, in addition, appliances for ignition, and (excepting in explosion turbines) compressors for air and for the combustible.

The interior of the combustion chamber is coated with a refractory material capable of resisting the heat developed; during its expansion in the discharge tube the temperature of the gas is lowered, and certain devices are sometimes employed to diminish its temperature still further before reaching the motor wheel.

Gas turbines are divided into 2 classes; explosion turbines and combustion or constant pressure turbines, quite analogous to the 2 kinds of cylindrical motors.

Explosion turbines have the serious defect of a variation of back pressure in the tuyere, from which there results a variable flow of the pressure of the gas upon the motor wheel. Now it has been demonstrated by M. Lemale that a given tuyere is adapted to a well-determined rate of flow, and to that only; the tuyere is at one moment too long and at the next too short for the work that is required of it, and the result is distinctly bad. The energy of the jet of gas is largely dissipated in shocks and whirls.

A combination of several explosion chambers supplying a reservoir and maintaining a mean pressure, can be imagined; but this storing of heat is not economical, for heat disappears as quickly as it has been generated.

However that may be, the explosion turbine has seduced many inventors, and in a pamphlet recently published by M. Venton-Dulaux, we find a description of numerous types of explosion turbine such as those of Messrs. Armengand, Esnauld-Pelterie, Karadovine and others.

M. Karadovine has invented a turbine making 10,000 r.p.m., which has been tested by M. Barbezat. A sectional view of the combustion chamber of this turbine is shown in Fig. 1. This chamber is of cast iron, the lower part of which is water-jacketed as shown at EE, the upper part of the chamber not being cooled, so that auto-ignition may take place. In the lower part of the chamber are 2 openings, A and P, for the admission of air and of the combustible (gas or hydrocarbon vapors). These openings are provided with throttle valves, so that the supply can be regulated. In the plate D is an opening for the admission of gas, which is covered by a steel plate held in place by a spring, R. The tuyere T leads from the upper part of the combustion chamber to the wheel W. Ignition is produced in the first place by the spark plub B.

To start the turbine the passage A is closed, the gases are introduced into the chamber C and ignited, in the first place by means of the spark plug. The upper part of the combustion chamber soon becomes heated sufficiently to cause ignition of the gas without the help of the spark plug. The sound to the successive explosions is quite similar to the noise produced by a Maxim gun.

A turbine of this type has been tested; each combustion chamber had a capacity about 14 cu. in. and carried a tuyere 118 in. in length and 5/8 in. interior diameter; the wheel had a diameter about 6 in.

The results were as follows:

Power measured by prony brake	1.6 hp.
Consumption of air per hour	2206 cu. ft.
Consumption of gas per hour	0.23 cu. ft.
Revolutions per minute	10,000

It is to be remarked that in this kind of turbine the combustion chamber is not closed at the moment of the introduction of gaseous mixture. Under these conditions it will be seen that it is not possible to have initial pressure, and that the combustible is exposed to considerable losses.

Holzwarth Turbine

IN the type of explosion turbine in which the gaseous mixture is compressed before each explosion, it can be understood that the presence of the valve in the

combustion chamber limits the maximum temperature in such a way as to impair considerably the value of the motor. Nevertheless certain inventors have produced turbines in which the combustion chamber is furnished with a valve, as in the Holzwarth turbine.

In a recent communication to the Schiffbauteshnische Gesellschaft, and analysed in "Le Genie Civil," M. Holzwarth has described his apparatus, which is manufactured by the Brown-Boverie Cie of Mannheim.

This turbine has been constructed to make 3000 r.p.m. and to develop about 1000 hp. when fed with gas of rather poor quality, having a heat value of about 112 to 135 B.t.u. per cubic foot.

The motor is composed of several explosion chambers, A, into which is admitted separately, by the valves R and P, air and gas at low pressure (about 20 lb. per square inch) by means of a special pump using the heat of the gas escaping from the turbine.

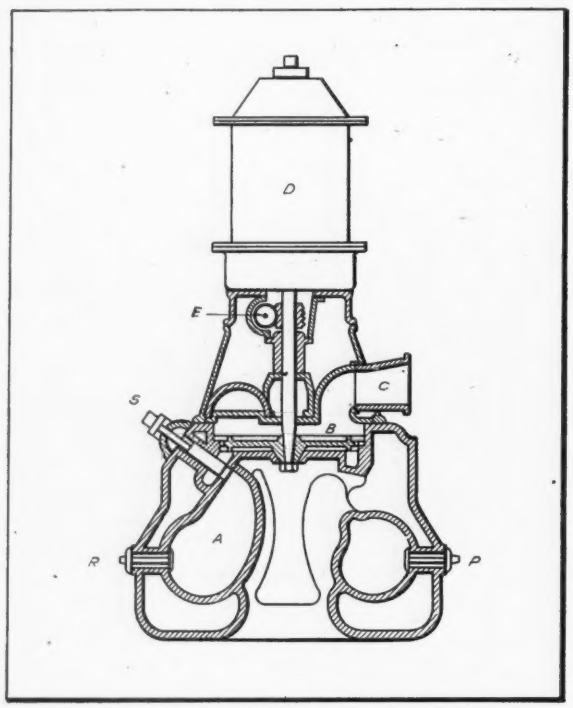


FIG. 2. HOLZWARTH GAS TURBINE

When the chamber A is full of the explosive mixture, it is ignited, producing a high pressure, about 100 lb. per square inch, which raises an escape valve S in the explosion chamber. This valve is furnished with a check or brake, working in oil, and being open gives access to the expansion chambers leading to the motor wheel. This is exactly similar to the wheel of a high pressure steam turbine, and the gases leaving it escape by the passage C, in which a low pressure is maintained. D is a dynamo keyed upon the turbine shaft and E is a horizontal shaft driven by a worm on the turbine shaft, and controlling the ignition regulator, a tachometer, the lubricating pump and the ignition apparatus.

The cycle of the turbine is as follows: when the explosion charge is ignited, the gases at high pressure contained in the combustion chamber A open the valve S and escape across the expansion chamber to the fixed and movable parts of the wheel B. The pressure of the gases in A diminishes progressively, then when this pressure has become practically equal to the atmospheric pressure, the admission valve R opens and the pump sends into the chamber A a certain volume of air, which cools it and drives the residual gases onto the wheel, which is made possible by the arrangement of the brake on the valve S between the combustion chamber and the turbine wheel, which retards its closure. Then the admission valve P delivers a new charge of gas and the successive operations of the cycle are repeated.

It may be remarked that from the point of view of thermal efficiency this motor is not very satisfactory, since the figures given by the inventor seem to indicate that the efficiency is never higher than 11.2 per cent of the total amount of heat disengaged by combustion, although certain modern reciprocating motors have an efficiency as high as 35 per cent.

The intermittance of the explosions in the chamber A and the progresive decrease in pressure of the hot gases lowers the mean useful pressure at the points of application of the turbine wheel to a maximum pressure determined in this chamber.

In other types of motors actuated by preliminary pressure followed by explosion, such as those of Messrs. Rusch, Puycuyor, Fasbender, Floran de Villipique and others, there is a wheel furnished with vanes forming explosion chambers limited in area by a fixed envelope. In these designs the effect of friction must be very considerable and it is reasonable to suppose that their efficiency in consequence will be very small.

To sum up, explosion turbines, for the reasons which have been indicated, do not yet appear to have furnished a satisfactory solution to the problem of the production of motive force, except perhaps for small powers and when the question of efficiency is not important.

There are also combustion turbines of constant pressure, which, however, are worthy of a separated description.

TWO WEEKS PRE-COOLING PLANT

HOW a pre-cooling plant, operating only 2 weeks a year, can be made to pay is explained by A. P. Criswell, a Chicago engineer, who installed the plant for the Pine Mountain Fruit Co., Warm Springs, Ga. The Georgia peach season lasts only 2 weeks, and before this plant was established ice cost the company $2,000 per season. The pre-cooling plant cost $10,000, all told. Two weeks' operation cost $150, and the saving in the fruit this past season, 100 carloads, is estimated at 15 cents per crate, so that the plant paid for itself the first season.

There was practically no loss by decay in the marketing of the peaches. Six to 11 carloads were shipped daily, and the work was done by a 50-ton second-hand machine, in a 25 by 100-ft. room, fitted with 6000 ft. of 2-in. ammonia pipe, direct expansion. The temperature was maintained at 32 deg. to 38 deg. F.—Cold Storage and Ice Trade Journal.

THE SIMPLEST and best way to free metal forms from hardened concrete is to heat them slightly and then cool them suddenly with cold water. The resulting expansion and contraction will break off the concrete. Care should of course be taken not to heat the forms so hot as to injure them.—Chain Belt.

STEADYING THE OUTBOARD BEARING

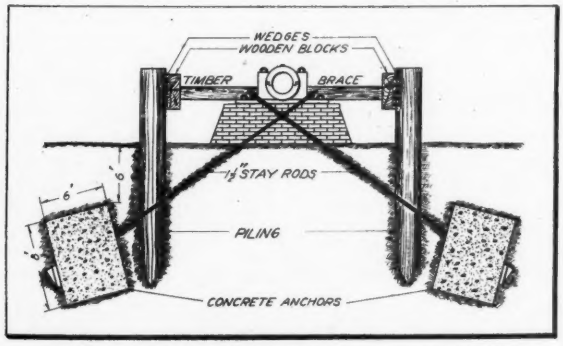
A Method for Anchoring a Rocking Bearing Without a Long Shut-down or Dismantling the Engine

By T. C. Robinson

On page 378 of the April 1 issue a subscriber inquires how to cure a rocking outboard bearing and in addition to the suggestion given there I would offer another, based on my own experience. In the first place, it is best to examine a rocking outboard bearing to determine whether it is level or not. In most cases I believe that the outboard bearing will be found considerably lower than it should be, because if the foundation rocks, it is sure to settle, and the bearing will go with the foundation. In such a case a shutdown is practically inevitable, and in that event the outboard foundation could be reenforced when the shaft was being leveled up by raising the outboard bearing.

In an experience with several rocking foundations, I have never yet found one that was not low and this does not always show up in hot journals and pins, either. On the engine of which I now have charge, the outboard bearing got down 7/16-in. before it got hot, and then only the outboard bearing heated up, the crank shaft being 14 ft. long.

As to the procedure necessary to steady the foundation without having to shut down the plant, the sketch herewith conveys a good idea of how we remedied our



ANCHOR ARRANGEMENT FOR ROCKING OUTBOARD FOUNDATION

own difficulty under conditions similar to those given. No attention has been given to proportions in this sketch as the conditions will vary and it is necessary to have all factors in order to determine these proportions; but they can readily be figured in each case according to the size of engine and the kind of soil supporting the foundation. Due allowance should be made for safety in deciding on these proportions.

First, construct anchors of concrete or stone as per sketch and of sufficient weight and placed deep enough in the soil to hold all that will be required of them. On our job the face of these anchors toward the engine foundation was made 8 by 8 ft., giving 64 sq. ft. of surface, and the top of the anchor placed 6 ft. below the surface of the ground, bringing the bottom about 15 ft. below the surface. Two of these anchors are needed and also 4 stay rods, 2 to each anchor. Probably you will have to crib the sides of the holes for these anchors, because otherwise the sand will cave in on you all the time you are excavating. Also it is likely that you will have to pump the water out to keep from filling the holes.

After the anchors are placed and the cement is dry, fill in with earth over the anchors and you are ready to pull up on the stay rods and all will work well; it did for us, for we could detect no vibration. You can then excavate around the old foundation and reenforce it without trouble.

In placing the anchors, remember that the farther they are from the bearing, the straighter will be the pull which is a great advantage. Be sure to have plenty of thread on the anchor rods, so that you can take up all slack and it is also well to drive a couple or 4 piles, as shown, for bracing the foundation, bringing the strain on these piles by means of wedges as indicated. I would place these piles in such a position that they can be used as explained in the April 1 issue for part of the foundation when the reenforcement is added, although the anchors will probably steady the bearing as much as may be necessary.

As to whether it is worth while to go to this expense to steady the foundation, depends on how much the loss would be by a shutdown but, if the outboard bearing is found to be low, a shutdown would seem to be inevitable.

SPEED OF THE GASOLINE ENGINE

Speed or velocity of the flywheels of the gasoline engine is limited first by centrifugal force, according to the Blacksmith & Wheelwright. The running velocity should not exceed 5,000 ft. per minute, as this is getting hazardously near the danger line where the rim of the wheel is liable to burst by reason of centrifugal force.

Then the speed of the flywheels is usually limited by the construction of the valve openings. This refers more particularly to the normal or actual working speed of the wheels. The normal speed of an engine may be defined as being that velocity or number of revolutions of the flywheels per minute as will best enable it to carry its full rated load constantly.

For instance, a 10 hp. engine will carry a 10 hp. load with the greatest fuel economy at 250 r.p.m. That is, below this speed it will not carry the full load and above this speed it will require more fuel; 250 r.p.m. therefore may be regarded the normal or most favorable speed of the engine.

The engine may have reserve power and be able to be crowded to 300 r.p.m. under a 12 hp. load, but since it is rated at only 10 hp. this would be considered an overload which is always regarded as abnormal.

No operator should require his engine to carry an overload continuously. Many a gasoline engine can not be forced beyond its normal speed under its rated load because the builders allowed only sufficient valve area for free successive inhalations and exhaust at a certain speed. Above the normal speed the breathing of the engine becomes choked, and it does not get a full charge at each inhalation. Neither can it succeed in getting rid of its exhaust product completely, and therefore, instead of being able to speed up under its full rated load and thereby delivering more power, it is limited to its normal speed and is not capable of an over load.

The speed of the gasoline engine under a load may therefore be said to be determined largely by valve area and by construction of inlet and exhaust passages. —Gas Power.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

QUICK METHOD OF OBTAINING M. E. P. OF INDICATOR CARDS

CUT a piece of tracing cloth to such size as conveniently to cover the card, allowing for paper weights at the ends to hold it smoothly. Rule the 10 spacing lines (which you otherwise rule on the diagram) across your tracing cloth as shown in Fig. 1. Lay your ruled tracing cloth over your indicator card and you have your lines on the card without marking it up.

Now, instead of taking a rule and measuring the various pressures along the card use a strip of paper, see Fig. 2. Hold it along line 1-2, and mark the effective pressure with a fine pencil mark on the edge of the paper. Move the paper to line 3-4, bringing mark 2 in line with 3 in the diagram and make a pencil mark on the edge of the paper at 4. Proceed until you have all 10 pressures down on the edge in succession. This work is easily done very accurately.

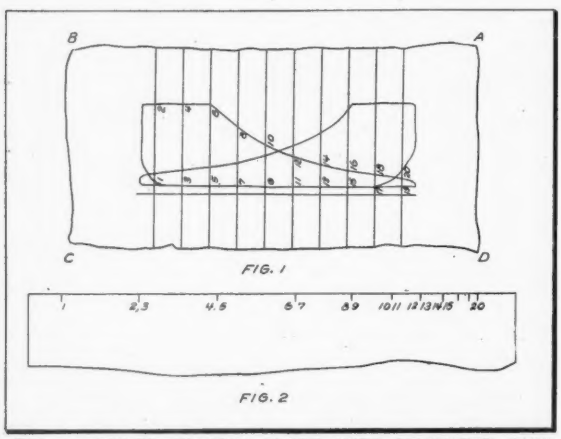


FIG. 1. RULED TRACING CLOTH OVER INDICATOR CARD
FIG. 2. PAPER USED TO SCALE PRESSURES

You need now but make one measurement, from 1 to 20, Fig. 2, and you have the sum of the 10 effective pressures. Move your decimal point one space to left and you have the m.e.p. for one side of the cylinder. Keep your tracing cloth flat by keeping it in a book, as it warps very easily. For more accurate work rule the lines closer, say ⅛ in. apart, and use on any card length, dividing the total measured effective pressures by the number of lines used. Frank J. Schnaubelt.

QUICK DRYING BELT CEMENT

IN the Sept. 1, 1912 issue, page 904, Chas. Fenwick asks for a belt cement that dries quickly. We have used quite successfully "Leather Belt Cement," made by Page Belting Co., Concord, N. H.

We rarely shut down much over an hour for splicing belts. L. B. Hedge.

"DOES THE INDICATOR LIE?"

A. C. WALDRON'S article under the above caption in the Sept. 1 issue is worthy of more than passing interest, inasmuch as this is one of the important points of valve setting on Corliss engines. I think Mr. Hawkins is right when he states that with the long cutoff the valve would be closed by the eccentric moving the wrist plate in the backward direction (on its return stroke), for, in accordance with all mechanical theory or practice, the eccentric would have reached its point of extreme throw before the piston had reached its mid position, "and would then be moving in the direction to close the valve instead of continuing to open it," and cutoff cannot take place while the eccentric and wrist plate are moving the latches back, away from the tripping cam, which is operated by the governor which would be in such a low position as almost to strike the stop motion pin.

Mr. Waldron states that steam lap would have to be added with a foot rule to a badly mixed up valve setting to return the wrist plate at ⅝ stroke. This is where he is wrong, for if it requires ½ or 1/3 of the eccentric travel, on one stroke of the piston, to open the port full width, after uncovering the lap, it must surely require the same ½ or 1/3 of the eccentric's travel during the return stroke of the piston to close the same valve, the same time admitting steam through the valve on the other end of the engine cylinder to push the piston back and complete one revolution, and in what position are the exhaust valves while this operation going on with respect to the steam valves, on a single eccentric Corliss engine? They are very apt to be late in release and choke the exhaust steam in its escape from the cylinder.

A single eccentric engine of the Corliss type can be made to take steam and be under the control of the governor as late as ¾ stroke, as stated by Mr. Waldron, but a single eccentric engine working under such conditions is no more economical than an ordinary slide valve engine on account of the back pressure on the piston at each end of the stroke, due to the choked exhaust ports, which makes it impossible to work a single eccentric Corliss engine economically unless it cuts off the steam, through the control of the governor, which, in practice, ranges from 1/5 to ¼ stroke, and can only be made later by removing the steam lap, instead of adding it, as stated by Mr. Waldron; so the steam valves would admit steam longer before closing.

It must be remembered that the crank travels one-third farther in a revolution than the piston does, and this accounts for a more rapid movement of the crank than the piston. I am speaking from practice as much as theory, and to prove the statement I am inclosing a pair of cards from an 18 by 36 by 36 single eccentric cross-compound Corliss engine and a card from the high-pressure cylinder under full load operation. I

must state there was an overload tax on this engine at times which caused it to stop and much trouble was encountered in getting it started again, as the machines which it operated had to be relieved of their material before starting, as the engine was direct connected to the machines. It was evident that a new engine must be installed, but this would require several months' time to construct and erect.

The engine was given a thorough overhauling and almost all the steam lap taken off the valve edges, and the right and lefts on the wrist plate connections shortened as much as possible. This brought the eccentric back to a little less than 90 deg. in advance of the crank which allowed the piston to travel farther before the eccentric reached its point of extreme throw and just trip the valve before it started on its return stroke to close the valve.

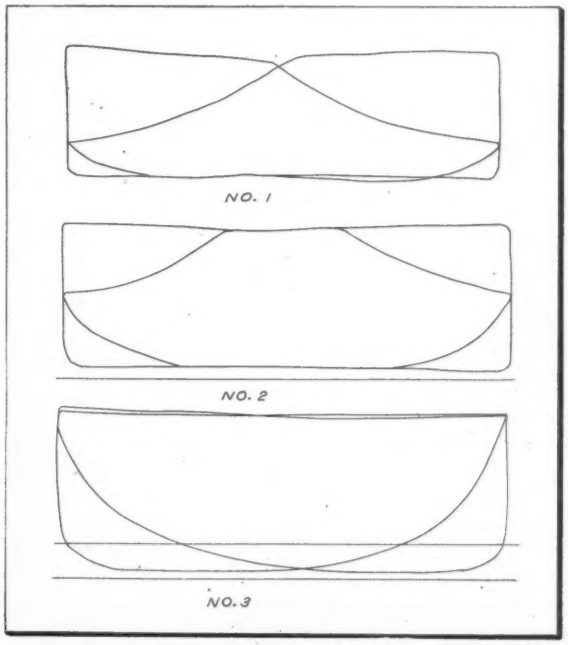
From the high-pressure card, after repairs, it is evident that the valve was tripped between ⅝ and ¾ stroke. It is seen that the steam was entering the cylinder while the valve was closing, as the expansion line did not fall or drop down to the proper curve after release and the terminal pressure according to the diagram is equal to about half the boiler pressure. Now, while this was taking place on one end of the cylinder the exhaust was taking place on the opposite end. The eccentric having moved 90 deg. at the beginning of the stroke to open the steam valve must again travel 90 deg. to open the steam valve to admit steam for the return stroke.

While this occurs, it opens the exhaust valve gradually, according to the "Chinese shoe shape" of the toe of the card, the steam escapes through the exhaust port and the terminal pressure drops to equal that of the receiver and back pressure line until the exhaust valve again closes for compression, which in this case was slight, and the operation is again repeated.

Two eccentrics are put on a Corliss engine for the purpose of getting a later cutoff without the excessive compression incumbent with a slide valve and single eccentric, while with the single eccentric Corliss engine the exhaust valves are closed at the point where they should be wide open to insure an economical working engine.

This theory is further borne out by the low-pressure card. It is seen that the receiver pressure follows the piston full stroke and the release line does not drop down to the exhaust line until the piston has traveled almost ½ stroke, then runs evenly along to the point where the exhaust valve closes for compression, which is much earlier in the stroke owing to the greater amount of exhaust lap necessary to overcome the vacuum, and as the return of the piston has completed the destruction of the vacuum in the cylinder it builds up the compression until it has reached the end of its stroke and the steam valve again opens. The valve gear on both cylinders of this engine is controlled by one governor and the receiver pressure therefore remains most constant. The engine now does the work without the usual stopping each time a sudden load is put on.

There are many technical points to be considered in the change made with this engine, and the practice of setting valves for late cutoffs, which cannot be clearly explained. One of these is that the dashpots of this engine and others of the same make are slow in operation, owing to their design and construction, which with normal loads does not interfere with proper regulation or economical operation. Another feature is the mechanical design and construction of the valve gear of the individual engine with which such changes are to be made, some are very limited while others allow for a wide range of mechanical alteration.



CARDS FROM HEWES & PHILLIPS COMPOUND SINGLE ECCENTRIC CORLISS ENGINE RUNNING AT 85 R. P. M.

I do not claim that Mr. Waldron is entirely wrong in his theory, but he did not state how this late cutoff was obtained, and the point of proof in his article is very meager and confused, and therefore misleading.

R. A. Cultra.

OIL IN BOILERS

AFTER reading letters by John Pierce, J. C. Hawkins, Roy Stahl and Thos. C. Robinson will state my experience with "Oil in Boilers."

Recently I was called upon to inspect a new boiler which had been in service just 23 days. This was a 66 in. by 16 ft. horizontal return tubular boiler and 1 of a battery of 6, all 150 hp., working under 125 lb. of steam. The boiler was made in 2 courses, one front and one rear, bringing a girth seam in center of boiler.

The caulking of the girth seam opened for a space of 9 rivets. I was on the job before the boiler was drained and when opened the sheet was covered over the entire length with a layer of oil about 1/16 in. thick.

The condensation from the exhaust from engines is all returned to the hot well and filtered through 3 compartments filled with excelsior to act as a filter. The water shows no trace of oil in its last treating tank, only appearing milky and the gage glass on the boiler showed no trace of oil.

If this boiler had not started leaking in the seam the plate would surely have been bagged.

In my experience as boiler inspector I find that a very thin coating of oil is more dangerous than heavy scale.

C. E. Aldrich.

IT TAKES PLUCK to succeed in speculation, and the man who does the plucking gets the money.—The Triumph Chronicle.

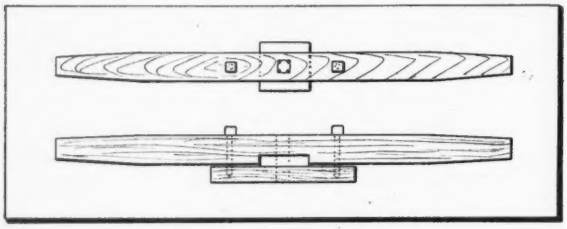
AN ARGUMENT is the longest distance between 2 points.—The Triumph Chronicle.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Die Holder

THE accompanying sketch shows how I made a simple and cheap die holder for small solid pipe dies. Take 2 pieces of hard wood 1½ or 2 in. square, one piece 18 in. long, the other 8 in. long, clamp the 2 pieces together with two ⅜x3-in. lag-screws, bore a hole through the center of both pieces the size of pipe to be cut. Take the pieces apart, cut out a notch in



HOME-MADE DIE HOLDER

the long one just to fit the die, but not quite as deep as the die is thick. Put them together again, leaving them a little apart until the die is slipped into the slot. Place the die central with the hole and then clamp up tight with the lag-screws. The hole in the short block will act as a guide for the die on the pipe.

L. M. Johnson.

A Condenser Pump That Gave Valve Trouble

IN taking charge of a 2,000 hp. condenser plant, I found no end of vacuum trouble.

The pump would run for 2 days and then the valves would break. On examination I found the drips on the steam chest and cylinders were piped into the discharge ell next to the pump, the steam blowing into the pump had a tendency to vulcanize the rubber valves. At a slight blow they would crack into many pieces. After the pipe was taken out and drips piped into the atmosphere this trouble was entirely overcome. R. S. M.

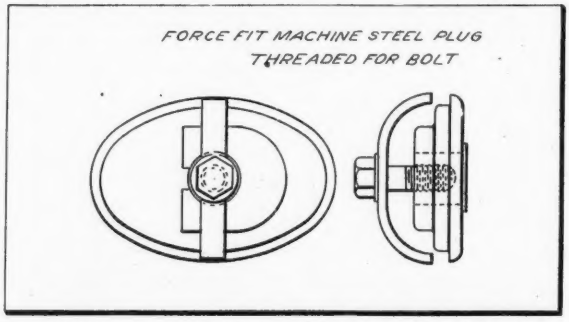
Washing Overalls

IN recent issues of Practical Engineer I have seen several devices for washing overalls, but think my machine better than any described. I took a barrel, cut a door in the side about 8 in. square, which was held in place by 2 bolts and 2 hinges. I took one set of ¾-in. flanges, bolted one-half to each end of the barrel and screwed a short piece of pipe about 8 in. long into each one, then set 2 posts on which to hang the box, then put a 2-in. belt from the line shaft to drive it. I also bored ½-in. holes around the barrel, 2 rows about 6 in. apart into which I put pins about 2 in. long. I then piped a ¾-in. line from the vacuum pump to it. When I wish to wash the overalls I put them in the barrel, run in some water put in ½ teacupful of boiler compound, the same of kerosene, ½ bar of soap, belt up, let run 1 hr., then wring out, filled up with clear warm water, let run for ½ hr., then wring out, rinse in cold water, and thus secure as clean clothes as could be wished for.

J. A. McQueen.

Hand Holes in Rear Heads of Boilers

AS regards hand hole plates in the rear heads of return tubular boilers A. A. Fidler covers the need of them quite thoroughly to which I agree. In new boilers I always specify them and cut them in old ones that come under my charge without them. My method of securing the plate differs considerably from that used by Mr. Fidler. I always have the plates drilled and a force fit plug forced in the hole and this plug is drilled and



REMODELED HAND-HOLE PLATE FOR REAR OF BOILER

tapped deep enough so that the bolt will not bottom, in this way the threads are in the comparatively cool plate and don't burn and you don't need to coat with plaster, keep the threads well coated with black lead and you will have no trouble with unscrewing the bolt.

J. O. Benefiel.

Filling for Grooves in Bushings

A GRAPHITE lubricant suitable for use in filling in grooves of brass bearings is one which is in the form of pure soft powder. It must for such purposes be used in connection with some suitable binder. We know of one concern who simply mixes it with enough hot paraffine to produce a heavy paste so that when this paste is poured into the grooves it hardens, the superfluous paste is scraped off and bearing is ready for use. In other instances pitch or some other similar binder is preferred. The United States Graphite Co.

Lubricant for Air Compressor

EUGENE E. HIBERT, in the Sept. 15 issue asks for information concerning the lubrication of his air compressor. He states that the use of oil is prohibited on account of the use to which the air is put. Is he sure that he did not use too much oil? An air compressor, especially a vertical type, will run with very little oil, and possibly a very little air compressor oil in which a little flake graphite is mixed will lubricate

the cylinder without any being carried over with the air. Soapsuds will lubricate the cylinder, and what goes over with the air will settle in the receiver, where it can be blown out, and would not have the effect on the air that oil does.

He states that he has used glycerine, but that it forms a coating on the compressor head. If there is no other objection to the use of glycerine I would suggest that he use it and give the cylinder a dose of soapsuds every day or two, which I think will cut this coating and it will be blown out. I have used soapsuds to cut a coating of carbonized oil out of air compressor cylinders with good results, and think it would work in his cylinder. Kerosene will also remove the coating that forms from the use of glycerine, but some of it would be vaporized and carried over with the air, which would prohibit its use in this case.

J. Case.

Raising a Stack

IN the accompanying illustration is shown a method of raising a stack which I have found successful. It consists essentially in the use of a wood pole bored at the top for a 1-in. bolt and the necessary tackle.

If rope is used for slings, I would advise 4 dead turns and 2 in block; hook both at mast head and on stack. Use a set of double blocks and rope not less than 2½ in. in circumference.

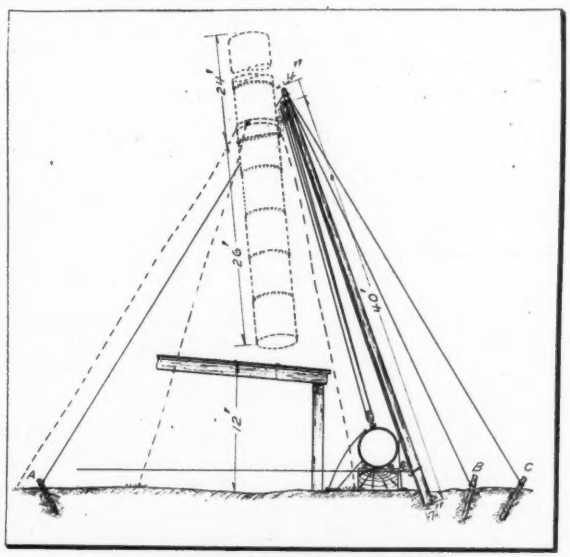


FIG. 1. RIGGING FOR RAISING A STACK

Good guy lines and secure anchorage is important, and the pole should be well stepped into the ground. With a 40-ft. pole there will be plenty of drift. It is much cheaper to rig well than it is to take chances on dropping the stack. The pole may be raised by laying top end on roof and hitching it up until the guy lines become effective.

E. E. Sarr.

Use of Graphite

IN answer to an inquiry regarding the use of graphite in boilers, in the Sept. 15 issue of Practical Engineer, I will say that I worked in a plant containing 6 250-hp. Babcock and Wilcox boilers, each of which were washed out and all scale cleaned from tubes and drums every six weeks.

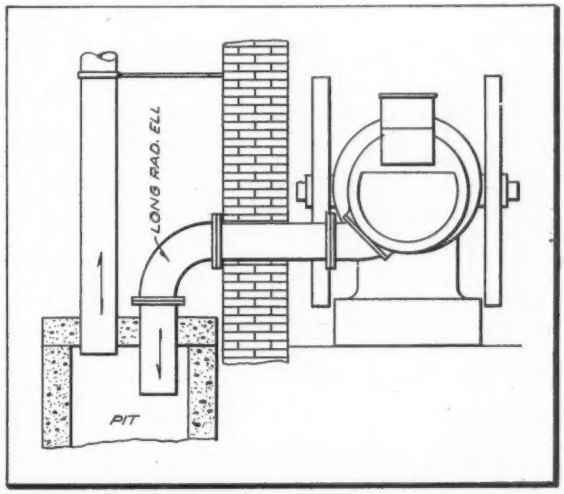
The last thing that was done before putting the manhole plates in place and the boiler filled, was to put about 5 lb. of flake graphite in each drum. This procedure was carried on with each boiler in its turn.

When a boiler was opened to be cleaned and the cleaner run through the tubes, the scale would come off in large pieces, leaving the metal clean. Upon examining the under side of a piece of scale, the flakes of graphite could be seen on the scale and had kept the scale from adhering so close to the metal. The same conditions were found in the drums.

I cannot speak on the scale preventing qualities of graphite, but I can say that it made the removing of the scale that did form much easier, which we engineers all know is quite a help. Fred L. Wagner.

Muffler for Gas Engine

REFERRING to the muffling pit for gas engines, on page 898 of Practical Engineer, would say it would be more efficient to come out from the engine and one long sweep ell into the pit. This will relieve the engine quickly and muffle just the same.



EXHAUST OF GAS ENGINE WITH ONE LONG ELL

Avoid every elbow or bend possible in the exhaust. make the expanse pipe as large in diameter, and as short in length as possible, it cannot be too large or too short.

Louis Bender.

THE HANDLING OF MATERIALS in large masses is by no means confined to steel plants. The Boston & Montana smelter, at Great Falls, Montana, is now operating a copper converter which will take approximately 50 tons of molten metal. It is of upright type and will have a weight of approximately 300 tons when full of metal. This converter has a diameter of 20 ft. and is declared to be the largest copper converter in existence.—The Iron Age.

WHEN COMPLETED, the Woolworth building in New York City will be the tallest building in the world. It will be 55 stories high and will contain 40 miles of steam pipe, 75 miles of electric wires and about 50 miles of plumbing. There are hundreds of men at work at the present time and the total cost will be about $14,000,000.—Gas Review.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Civil Service Examination

AS there is very little information to be had regarding the licensing of engineers in New York City, and thinking some of your readers would be interested with what little there is to be had, I am sending you a clipping cut from a civil service paper called the Chief.

John Mitchell.

Second Class

Examination for Engineer's Certificate of the Second Class, held at police headquarters by the Steam Boiler Inspection and Engineers' Bureau, on June 27, 1912.

Boilers

1. Find the horsepower of a horizontal tubular boiler 9 feet long, 42 inches in diameter, 32 3-inch tubes.
2. In placing 3-inch tubes in the head of a steam boiler, what size bridges should be left to allow for the proper amount of heating surface and circulation?
3. What distance apart should ¾-inch rivets be driven in a boiler?
4. What do you consider perfect combustion?
5. If you opened your throttle or safety valve suddenly, what effect would it have on the water line?
6. How many square feet of heating surface to a horsepower?
7. What are separators and where are they generally placed?
8. Where should the bottom try cock be placed on a horizontal tubular boiler, in relation to the tubes?
9. Which is the better in cleaning tubes, a dry brush or a steam jet? Why?
10. What is the object in placing try cocks on an angle in the head of a steam boiler?

Engines

1. Draw a diagram of an indicator card, single stroke, showing too much compression, leaking slide valve, point of admission and expansion line.
2. How would a leaky piston show on an indicator card?
3. What is "initial pressure?"
4. What is the "mean" pressure in a cylinder.
5. What is "back" pressure?
6. What is meant by expanding steam or working steam expansively?
7. Having a 6-inch cylinder, 10-inch stroke, what size steam and exhaust pipes are required?
8. What is the object of putting inside "lap" on a valve?
9. How would you set a valve that was controlled by a wheel governor?
10. Which stroke requires the most steam on a horizontal engine, the outward or backward, and why?

Dynamos and Ice Machines

1. If a compound wound dynamo was running parallel with another machine of the same type and the belt should break, what would result?
2. If you were to connect a wire screen across the armature of a compound wound dynamo, short shunt, and start up dynamos, what would result?
3. How does the alternating and the direct current generator differ?
4. What is produced in conductors cutting lines of force or in lines of force cutting conductors?
5. (a) What is meant by "revolution?" (b) How many strokes has it?
6. (a) What is a field? (b) What are magnets? (c) How is the current generated?
7. (a) What does an armature consist of? (b) How is the current conducted to the lamps?
8. Where does the expansion of ammonia take place in the direct expansion system?
9. What would cause an ice machine compressor to burst?
10. How do you control the head pressure?

Third Class

Examination for Engineer's Certificate of the Third Class, held at police headquarters by the Steam Boiler Inspection and Engineers' Bureau, on June 27, 1912.

Boilers

1. Draw a diagram of a steam boiler, any type, showing all connections.
2. Find the safe working pressure of a steam boiler, 50 inches in diameter, ⅜-inch shell, double riveted longitudinal seams.
3. State in detail what action you would take if you had a high pressure of steam on your boiler and you could not find the water level until such time as the boiler was replaced into service.
4. (a) Which part of a horizontal tubular boiler is generally made heaviest? (b) State why.
5. State what appliances you are govened by to obtain a true water level in a steam boiler.
6. (a) What is the meaning of a "bridge-wall" in a steam boiler, and where is it located? (b) Where is the "mud-drum" in a steam boiler, and what are its uses?
7. What are the common causes of boiler explosions?
8. What is the object of a blowoff, and how often would you examine it?
9. What is the principal valve on a steam boiler?
10. What are the appliances generally used for feeding boilers?
11. Name all of the connections which should be placed on a long main steam pipe 50 ft. long, 8 in. in diameter, running from the boiler to the engine.
12. If you were in the engine room, how would you know the boiler was "priming?"
13. State all the advantages of a steam dome.

14. What are stay bolts, and what part of a steam boiler are they used in?

15. Name the different kinds of patches used on a steam boiler. (b) Which is the most reliable? (c) And why?

Engines

1. (a) What is meant by "lead?" (b) What is meant by "steam-ports?"

2. State how you would square a shaft with the cylinder if the shaft is out of line.

3. (a) In setting a slide valve on an upright engine, where would the most "lead" be given, on top or bottom? (b) Why?

4. What drives the piston ahead when the valve closes?

5. (a) How is a leaking slide valve detected? (b) A leaking piston?

6. What is the most practical way to finding "clearance" in a steam cylinder?

7. How is the supply of steam to and from the cylinder controlled?

8. What is the effect on an engine if the exhaust is liberated too soon?

Pumps

9. What is the difference between a single and a double action pump?

10. State in detail how the valves on a double action pump should properly be set.

11. (a) How many valves are generally on the feed line between the pump and the boiler? (b) Name them, and (c) state fully the functions of each valve.

Starting a Corliss Engine

WILL you please give me instructions for starting and stopping a Corliss engine? R. D.

A. There are so many different events that enter into the question submitted by you, that it will be impossible for us to cover the ground in our reply so as to be applicable to all conditions. We will assume that the Corliss engine be of the simplest type as generally encountered in every day practice, and that everything has been left in good order by your predecessor on the job.

First, make a casual examination of the engine so as to become acquainted with it in a general way, observing its peculiarities, if there are any. Then fill and start the oilcups and oil all parts of the valve gear, rods, etc., not forgetting the governor.

Open the throttle valves slightly, (or the by-pass, if there is one), admitting steam to the cylinder to warm it up, meanwhile working the valve gear by means of the starting bar, so as to warm and drain each end of the cylinder thoroughly, and later on by admitting a little more steam. Allow the steam to accumulate on each side of the piston long enough so that the piston will begin to move a little. Then by reversing the valvegear with the starting bar, work the piston back again through a portion of the stroke, repeating this several times, taking care that you do not stop the engine on the center.

Having consumed about 2 to 3 minutes on the above, connect the hook rod to the wrist plate quickly and admit a little more steam so that the engine will revolve slowly. Then while it is turning over slowly, go around the engine again and see that all the oil cups are in operation and that there are no loose connections or interference any where. Get to know your engine as soon as possible after taking the position.

If all is working well, gradually open the throttle a little at a time and bring the engine up to speed, and after the engine has come under the control of the governor, open the throttle full. It is good practice to have the engine up to speed and working freely not less than 3 to 5 minutes before it is required for service.

When necessary to stop the engine, close the throttle and let the engine speed gradually reduce till it is almost stopped, when by disengaging the hook rod, and inserting the starting bar, the valve gear can be worked by hand, and by using good judgment, the engine can be stopped with the crank pin on or near the "quarter," from which position the engine can be easily started. Shut off the oil.

On very large engines equipped with a bypass, it is almost a universal custom to leave either the throttle or the bypass valve open a little when stopping, to keep the valves from rattling on the seats, till the speed has been reduced to, say, 10 or 12 r. p. m., after which the valve can be closed entirely.

In handling a tandem Corliss engine, the method of procedure is practically the same, as the valve gears of both cylinders are handled in unison by means of the connecting hook rods. Cross-compound engines, almost without exception, are constructed with the crank pins at 90 deg. to each other, so that there is no point in the revolution where it is impossible to start the engine, either by the main throttle, or by admitting steam to the receiver by means of the bypass, which is generally provided by all builders, or if not, is easily attached by the engineer.

If the engine is operated condensing, by means of a separate condenser, start the condensing apparatus before starting the engine. However, if the condenser is operated by the engine direct, by a belt or connecting rod attached to some reciprocating part of the engine, the condenser will begin operations as soon as the engine begins to revolve.

We are sorry to say that there are some so-called engineers who are so unscrupulous as to tamper with the engine when they leave a position, by tightening or loosening the bearing bolt nuts, or changing the adjustment of the side rods or valve gear, or even by introducing some foreign substance into the cups or even the bearings, such as sand, iron chips, etc.

Unless you are absolutely sure that your predecessor left the position in good standing, it will save you considerable trouble if you make a close examination of every part of the engine before putting it in operation. This does not necessarily mean that the engine be taken apart, but one who has had any experience around engines can tell by examining the various nuts, whether or not they have been loosened recently.

As for the main bearings, pins, etc., look to them closely, as a few grains of sand introduced into them with malicious intent, would soon ruin these parts and cause endless trouble. At any rate, keep your head, and it will save your hands and feet a lot of work.

G. H. Wallace.

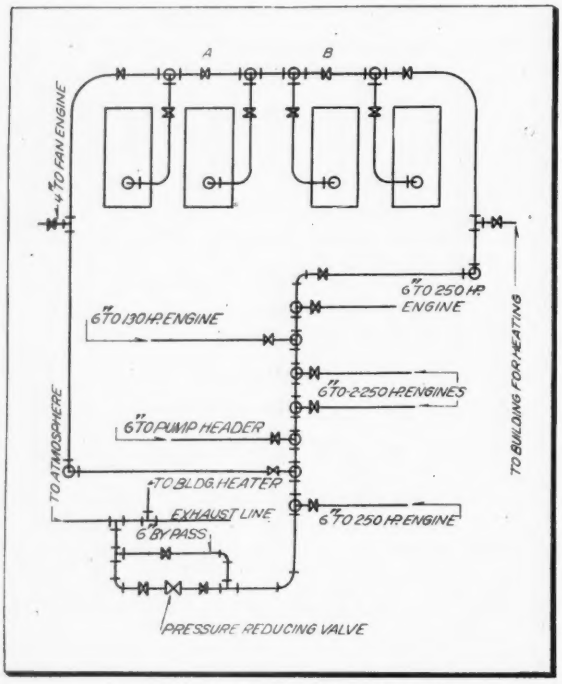
THE FIRST STEEL produced in this country was probably made in Connecticut in 1728 by Samuel Higley and Joseph Dewey. Crucible steel was first successfully produced in the United States in 1832 at the works of William and John H. Garrard, at Cincinnati, Ohio. Bessemer steel was first made in this country in September, 1864, by William F. Durfee at an experimental plant at Wyandotte, Mich., and open-heart steel in 1864 by the New Jersey Steel & Iron Co., at Trenton, N. J.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Location of Valves

ANSWERING J. C. Hawkins' inquiry, on page 795 of the Aug. 1 issue of Practical Engineer, as to the best location of valves, I wish to submit the accompanying sketch.



MR. DIXON'S ARRANGEMENT OF VALVES

Valves A and B are not absolutely necessary, but if installed will pay for themselves more than once.

William E. Dixon.

Belt Cement

ANSWERING the inquiry of Chas. Fenwick, on page 904 of Sept. 1 Practical Engineer, in regard to belt cement, I would say that the Gehulk Belting Co., St. Louis, Mo., manufacture belting cement which dries quickly. It has been successfully used by the writer. Any further information will be gladly given.

Julius M. Morenci.

Correspondence Instruction

BEING a reader of Practical Engineer, I would like to have this question discussed in its columns by readers who have tried the correspondence method of study: Can one learn engineering by correspondence?

Oliver W. House.

Commutator Sparking

REPLYING to the inquiry of G. E. G., in the April 15 issue, as to what makes his commutator spark: I believe I had nearly the same experience a few years ago. Lightning entered the station, creating a flash at the generator, at the same time the circuit breaker tripped.

After bringing up the voltage and setting the breaker, everything went well for a short time, then I had his troubles, as the spots on the commutator were exactly under the brushes at the same time and they don't wear down with the rest of the commutator, which causes brushes to jump. C. D.

One Engineer's Opinion

IN a recent issue of Practical Engineer J. R. wishes to have the opinion of brother engineers in regard the number of gages of water that should be carried in a return tubular boiler. Up to this time I have seen no opinion submitted, and as this subject is worthy of much consideration I give here my opinion, hoping that it will bring about further discussion, as there is much that can be said on the subject.

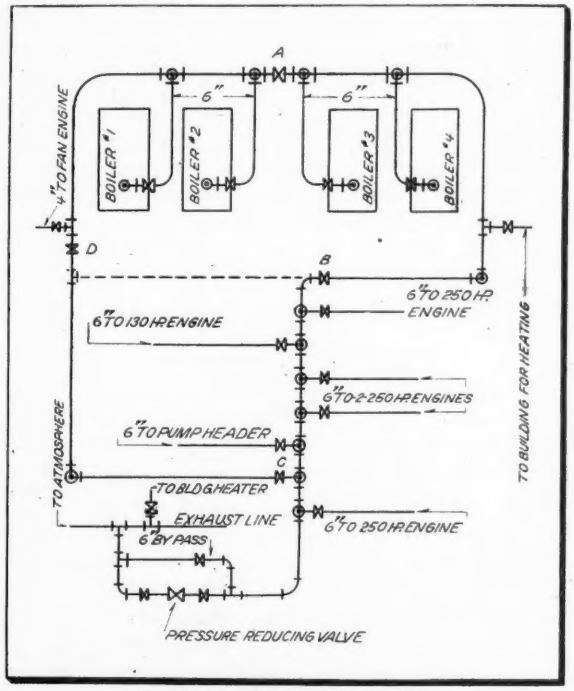
The number of gages to be carried in a return tubular boiler will depend on the height of the water column, which, if properly located above the top of the upper row of tubes, will give 2½ gages as the normal or mean water level. This mean water level will vary to some extent for the reason that the distance between the centers of the gage cocks are not the same on all makes of water columns. The water column is one of the engineer's safeguards, and for this reason should be properly placed so that when the water appears in the glass there will be a safe depth of water over the tubes.

I always make it a practice to place the bottom of the glass 3 in. above the level of the top row of tubes, and by so doing I am sure that the fusible plug is covered with a sufficient depth of water. Take, as an illustration, the case where the fusible plug is placed in the back head 2 in. above the level of the top row of tubes, a water column placed at this height would insure a depth of 2 in. of water above the fusible plug, providing the boiler had a pitch of 1 in. of its entire length toward the back head.

This would give us a variation in water level of anywhere from one to 2½ gages. Take a water column on which the first gage cock is 2 in. above the bottom of the glass, and between centers is 4 in., this would give us when carrying 2½ gages of water a height of 11 in. above the level of the top row of tubes, which leaves ample steam space providing the tubes are not placed too high. W. S.

Card From an Old Engine

IN criticism of the indicator diagram submitted by John Graham, I wish to say that I consider it very good with the exception of the admission line, which seems to indicate wire drawing due probably to small valve opening and long steam line. The cutoff is a little later on the head end than on the crank end, the m.e.p. being, head end 32 lb., crank end 31.3 lb. The engine constant is 4.003, and the i.hp. is, head end 128 and the crank end 125.3 or 2.7 hp. difference. The total i.hp. is 253.3. In plotting the theoretical expansion curve on the head end diagram, there appears to be a small amount of leakage in the steam valve, although it may be possible that both the steam and exhaust valves are leaking, in which case the amount of leakage shown will only be the difference between the leakage in through the steam valve, and the leakage out through the exhaust valve.



W'S ARRANGEMENT OF VALVES

In figuring the steam consumption of the engine from the diagram I have assumed the clearance to be 5 per cent and find the steam consumption to be 20.3 lb., per hp.-hr., and as this compares favorably with the actual steam consumption of a simple corliss engine, I think there is very little leakage in the valves, and the general efficiency of the engine is good so far as can be determined by the indicator diagram, which is printed ¾ actual size. Mr. Graham states that the engine was built in 1881, but does not state whether the cylinder and valve chambers have ever been rebored or not. If it has never been rebored I think it is in remarkably good condition after 31 yr. use.

J. C. Hawkins.

Will Snow Short Circuit?

THE article in the Sept. 15 issue of Practical Engineer, telling of how a plowed field acted as a line conductor recalls a couple of similar conditions that have come under my observation. These conditions tended to cause short circuits, but did not.

The first experience was in a railway plant. One winter morning the first car out of the barn pulled an overhead switch down into the snow. The ammeters showed a total of 400 amperes and after they had held there steady about half a minute I knew something was wrong and threw the breakers out by hand. I had just got them out when the car barn man called up and told what the trouble was. I was surprised to think that the current had not been strong enough to trip the breakers itself. I finally decided that the snow was so dry that it did not make an exceptionally good conductor.

My next experience was more of a surprise than the first one. At the plant here we have a 13,200-volt line running 7 miles to some granite quarries. About 11:30 one morning, it also was in winter, the line switch went out with a bang. I waited about 3 minutes in order to give the quarry operators time to get their switches out and threw the switch in again. It stayed. The ammeters are on the 2300-volt side and 2 of them showed 25 amperes; the other was hung up in the corner on the edge of the scale so I could not tell what was on that. A minute or so after I had the switch in, the electrician of the quarries called up. I told him I had the switch in, but he said he did not get any current. I fixed the ammeter and it showed zero, much to my surprise. Just then the man who was cutting ice on the dam came in and said that a tree had been chopped onto the line and that 2 wires were down in the snow. I pulled the switch in a hurry.

I can see in the first case where with only 600 volts there wasn't an excessive current produced, but when I realized that 13,000 volts were cooling themselves off in the snow without causing trouble, I will admit they "had my goat."

W. H. Thompson.

Location of Valves

IN regard to location of valves in piping layout, asked by J. C. Hawkins in Aug. 1 issue of Practical Engineer, he does not state if the fan engine runs continually, neither does he give the length of any of the piping. I have marked my idea of the location of the valves in the sketch by an X.

By locating a value A in the center of the main header, the line can be divided and in the summer, when no heating is required, steam can be taken from No. 1 or No. 2 boiler, or both, and passed at left-hand side to fan engine and main line; in this case valve B would be closed and that part of the line at right-hand side be cut out. Steam could be taken from No. 3 or No. 4 boiler and passed at right-hand side, and if fan engine does not run continually a valve placed at C on fan engine line would cut out that side.

If the fan engine must run continuously, and if the distance from the fan engine to main line is great, then the valves placed at C and one at D would allow that part of line to be cut out, and steam supplied through main header from right-hand side. If the line from fan engine could be run as indicated by dotted lines, it would do away with quite a length of piping.

W.

LUCK NEVER comes to the man who spends his time looking for 4-leaf clover.

WE ARE ALWAYS willing to lend a helping hand to the fellow who don't need it.

ABOUT THE BEST thing a man could own these days would be a meal ticket for life.

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RECORDS FOR SMALL PLANTS

Engineers of small private plants are beginning to realize that it is fully as important for them to keep a daily log as it is for the large plants and we are glad to see that there is an awakening to this fact.

It means self protection to the engineer and intelligent records that show definitely the cost of producing power will make the boss sit up and take notice. On another page of this issue there appears an article that shows conclusively how the central station's claim for more economical service than could be supplied by a private plant was entirely incorrect and if it had not been for the systematic records kept by the engineer of the building during the 5 yr. that central station current was used, the company who employed the engineer would probably be using it to this day.

As a result of records and statistics of fuel used for heating and the cost of current from the central station a plant was installed, patterned after the engineer's suggestions, and has been the means of reducing the power bills 50 per cent. This is only one illustration of probably a great many such instances.

Another point to be considered is, that without records of a plant in operation, there is no means of combating the claims of the central station solicitor, and he is much more liable to gain his point where there is nothing to show the cost of the private plant's operation.

OFF DUTY

Asleep

America is fond of play and sleep. That sounds like heresy after all the talk of the past about the hustle and hard work of our country; but a look at the records will show that we toy with new devices, we doze and dream in snug complacency until somebody has made our toy into a useful tool; then we wake up, stretch ourselves and proceed to go Mr. Somebody one better by improving and cheapening the tool until we have what we consider sufficient lead. Then another nap until some other rude shock awakens us.

Mechanical ability we have; ingenuity and inventive genius we have; application (by spurts) we have; but in developing new lines of human activity, except such as from local conditions are peculiarly our own, we have not compared favorably with the older nations, nor do we now.

Considering any line, steam engines or turbines, oil engines, automobles, boilers, steam ships, chemical engineering, textiles, toys, what you will, our products are based on pioneer work done by our European neighbors, even though they may compare at present with the best from abroad.

Why all this scolding? Well, we're asleep again—or yet. Who has heard of any serious attempt in America at a real air ship? We are playing with aeroplanes, races, toy bombs, experiments—when the wind is right,—and goodness knows we are spending enough on them in money and lives. But a real

air ship? Not one, spite of Wellman's fiasco when he saved the cat. What continuous flight had he or any other American ever made over land in a dirigible that justified him in attempting the more difficult over-sea trip. That was simply a play to the gallery without a possibility of success.

Then look "across the pond," and read an article in Everybody's for September on "Greyhounds of the Air" to get an idea of the progress that has been made and how much we have been dozing and playing with our toy, the aëroplane, at which the Frenchman, Vedrines, has recently beaten us unmercifully.

Air ship service, express and local, between the principal cities of Germany, voyages of 500 miles without stop, ability to stay up 48 hr. if necessary and to cover 60 miles an hour, lengths of 563 ft. and projected lengths of 1000 ft. with passenger capacity of 100 and all the comforts of Pullman travel,—these are not dreams,—they are German facts. And they pay! A profit of $83,000 in a year on an investment of $125,000, with a possible life of 7 yr. more is good enough even for the American desire for large and quick returns. Yet, while our travelers abroad patronize these "air lines" and help to pay that profit, no American air ship of commercial size or quality has been built. With our long jumps, our expensive traveling habits and desire for novelty, this would seem to be the ideal country for rapid development of real air navigation.

But we are asleep.

EXTINGUISHING A FLAMING GAS WELL

THERE are various tricks resorted to for extinguishing blazing gas wells. A well at Lone Pine, Pa., with an 8-in. casing and a capacity of 5,000,000 cu. ft. a day, was struck by lightning recently and the flame lighted the country for miles around, while the heat was so intense that operations nearby were impossible.

After 3 days a very simple device gave quick success. By the aid of long ropes a boiler stack, with a base mounted on rollers and guys to keep it upright, was moved over the well, the flame then raging at the top of the stack. A sudden jerking away of the stack made a break in the gas current and the flame went out instantly.—Compressed Air Magazine.

RAINFALL, EVAPORATION AND DRAINAGE

DR. GEORGE A. LINDSAY, in the Transactions of the Academy of Science, St. Louis, give in novel and striking form some interesting statistics of annual rainfall. The rainfall in the State of Missouri in a single year was 43.9 cubic miles. In the same year 1,296.4 cubic miles of water is computed to have fallen over the whole area of the United States. These figures are tolerably comprehensible, but when we are told that the latter figures represent 6,000,000,000,000 tons of water then we are at sea again.

As an illustration of the fact that most of the water that falls as rain never reaches the sea through the medium of drainage, but is evaporated from the land, Mr. Lindsay shows that the discharge of the Mississippi River at St. Louis is but little greater than the volume of rainfall over the State of Missouri alone, despite the enormous area drained by the river above that point.

WHAT THEY DO WITH THE NOON-HOUR

The Journeyman Engineer

IN a small town not far from Chicago, lives a young assistant engineer who gave me a valuable hint.

This young engineer did not have the educational advantages of the men above him, but with a firm desire to get there, he has used every minute of his spare time for self-education, which you will agree is one of the ways to reach the coveted goal.

It was some time before he fully realized how much he had really learned from the hours spent studying and not until the chief commenced to talk over some of the problems to be solved in the plant, did he have a feeling of satisfaction over his acquired knowledge.

In one of these talks with the chief, the conversation turned to the capability of the other men in plant and the progress they had made during the year. Not another man except this assistant seemed to be any better fitted for greater responsibility than when he had started to work.

The chief commented at length on this fact and asked his assistant the secret of his own progress. The assistant told him the amount of time he had put into studying Practical Engineer, writing for information, reading books and working over possible emergencies that might have to be met in their plant. With the educational thought always in his mind he never overlooked an opportunity to acquaint himself with every new kink described.

When I called at his plant, the assistant told me what the outcome of this last talk with the chief had been.

They have started a noon-hour educational club in which every man connected with engine room participates. The assistant engineer is the organizer and carries on the work done by the club. The chief acts as the adviser and as a ready reference.

A series of questions is handed around to each man to solve. The following week, the chief and assistant go over the answers with the men and a general discussion about the subject is taken up. Reference is made to articles on Practical Mathematics, Slide Rule Practice and Practical Lessons on Electricity which are published regularly in Practical Engineer.

These articles form the basis of many of their lessons and Practical Engineer has offered the services of the editorial department to carry on the work when needed.

The men in this plant have the correct idea of progress; by getting together at noon in friendly discussion over the problems of their work, they are not only being greatly benefited themselves, but are also increasing the efficiency of the plant in which they work.

ONE ENGINEER WHO USES GRAPHITE constantly, states that for the first 30 days he used to mix 1 lb. of graphite with a pail of water for each 100 boiler horsepower, and pumped it into the boiler each night. After the first 30 days, he pumped in the same quantity once or twice a week, and found that it made the scale easy to remove.

Another practice is to throw in about a gallon or, say, 5 or 6 lb. of graphite after cleaning the boiler, and use no further treatment until the boilers are next cleaned, when the scale that has formed is found to be soft and easily broken up and cleaned out.

ENGINEERS IN ST. PAUL

What the International Delegates Did at the Big Convention, Sept. 9-14

WHILE the International Convention of the Steam Engineers was in session in this city, the weather was propitious and helped to make the proceedings of the convention interesting and enjoyable. Evidently the gods who rule the roost in atmosperic conditions were favorably disposed, and seemed to think the convention was an affair of unusual importance, so made the temperature suit the requirements.

The committee which had the arrangements in charge took a broad, comprehensive and discriminating view of its duties, and laid down plans varied enough to cover all possible requirements and bring the most desirable results. Features for the entertainment of the delegates and their accompanying friends were judiciously interlarded to relieve the more serious work which engaged the delegates most of the time, and the enjoyable events provided proved to be among the incidents of the convention most appreciated and longest and most happily to be remembered. The session of the convention proper were held in the assembly room of the Ryan Hotel, where everything needed for the prompt and intelligent dispatch of the business was provided.

While the committee neither neglected nor omitted anything needed for the comfort of the delegates or the proper and prompt dispatch of the business of the convention, it gave special attention to the comfort and enjoyment of the ladies in attendance. To provide for their enjoyment, it arranged a series of entertainments as comprehensive in scope and varied in character as the circumstances would permit, including morning, afternoon and evening events which presented a continual change of program and novelty of attraction, and the ladies expressed themselves as thoroughly pleased with them from beginning to end. The program included theater parties, trolley rides to all the historic scenes and natural beauties of this region, afternoon teas and social features of every kind available at this season of the year.

Delegates Warmly Welcomed

WHEN the time came for the opening of the convention, Mayor Keller of St. Paul was on hand and tendered the delegates a most cordial and appreciative welcome to St. Paul. Victor E. Patnaude, Chairman of the General Committee of Arrangements, called the meeting to order, saying that it gave him great pleasure to extend the hospitalities of the city to the visitors. He then introduced Mayor Keller, who said in part: "We in St. Paul are ardent believers in the value of organization. We know that a great deal more can be accomplished when many minds work together for the common weal than when individual workers are straining and pulling apart. We realize here in the great Northwest the tremendous impetus that has been given this wonderful American Empire of the West, and through it the whole world, through inventions in recent years, in which the engineers have fully held their own with the other crafts. You gentlemen represent one of the greatest industries in the world today, one that has contributed as largely as any other to the material progress we have in the last century. As the mayor of this city, I extend to you a sincere, a double welcome, and I wish to congratulate the local committee on the promising result of its arduous and sincere efforts to make your stay here a pleasant one

E. C. Hall, President of the Minnesota State Federation of Labor, was next introduced by Mr. Patnaude, and welcomed the convention to Minnesota most cordially in the name of the organization he represented. He was followed by Collis Lovely, general organizer of the Boot and Shoe Workers of America, who tendered the best wishes of his organization for the success and full enjoyment of the convention, and urged the delegates to be insistent and determined, as well as constant, in the demand for the union label on all their purchases.

Comerford Takes Charge

AT the conclusion of Mr. Lovely's address Mr. Patnaude turned the gavel over to Matt Comerford, President fo the International Union, who after a brief response to the addresses of welcome declared the convention regularly open for the transaction of business and called for the report of the committee on credentials. This report was made and the delegates recommended in it as entitled to seats in the convention were seated, the few contests before the committee being left for action on a subsequent report of the committee.

At the session of Monday afternoon the regular standing committees of the convention were announced by the president, and the delegates settled down to the serious work for which they had been convened. The first order of business was reports. President Comerford's report summarized what had been done in the last 2 yr. and graphically outlined the work to be done during the next official term. It showed that the executive officers had dealt promptly and effectively with many problems in which the welfare of the craft was involved and that the disposition of these cases had brought universal commendation.

In conclusion, the report of general president showed that there had been a gain in membership of nearly 5000 members in the past 2 yr.—thus bringing the membership of the organization well along towards 20,000.

The report of general Secretary-Treasurer took up but little time as on motion of the convention the report was sent to the printer without reading. The convention then adjourned until Tuesday morning.

Tuesday's session dealt with the work of the law committee which took up a great deal of time as a many amendments to the Constitution were presented. The one which brought out the most debating was the proposition to take in the Staionary Firemen and Oilers as apprentice engineers; after considerable debate this was finally referred to the American Federation of Labor Convention.

On Tuesday afternoon the ladies of the convention were guests of the Orpheum Theater, and there was unusual interest taken in the entertainment as the management of the theater had put on a special play for the benefit of the guests of the convention.

Wednesday's Session

ON the opening of Wednesday's session the law committee still occupied the attention of the convention with many of its amendments to the constitution yet to be considered.

After several hours debate on these, the convention adjourned to give the delegates an opportunity for an

early luncheon and an automobile trip around the Twin Cities, passing the historic old Fort Snelling, and from there to Minnehaha Falls, where a picture of the convention delegates was taken. From there the convention proceeded through the parkways of Minneapolis and on to the plants of the Minneapolis Brewing Co. and the Gleuk Brewing Co. where a German luncheon was served. The return trip was made via the University of Minnesota, State Agriculture School, and the State Fair Grounds.

All were highly pleased at this entertainment but a slight mishap marred the enjoyment of some few, as in returning, one of the automobiles which was carrying the delegates had a mishap and a delegate was thrown from the car and slightly injured. He was immediately rushed to St. Barnabas Hospital for medical treatment, and after a few hours his injuries proved not as critical as was feared. Within a few days the delegate was back at the Convention Hall, able to debate with the best of them. While the guests of the convention were enjoying this automobile trip about the Twin Cities, the ladies of the convention enjoyed a tally-ho ride covering practically the same ground.

Thursday and Friday

THE balance of the work of the law committee took up the greater part of the day, and an adjournment was reached early in the evening to attend the entertainment which had been provided at the Woodmen Hall of St. Paul. President Matt Comerford put on canvas moving pictures exhibiting advertisements of the Journal, followed by a series of pictures showing the evils of child labor and other educational pictures which proved very interesting to the delegates and guests. At the completion of these pictures, the chairs were removed from the hall, and the delegates and guests enjoyed dancing until 11:30 when the convention committee announced that refreshments had been provided for the delegates and guests on the floor below; accordingly all repaired downward where a splendid banquet was served to approximately 400 delegates and guests, after which dancing resumed until a late hour.

Friday was occupied by the report of the resolution committee which had a great deal of work before it. Most of the resolutions were referred to the general executive board for the ensuing term. The grievance committee also made its report, which was short and concise, and the committee on charters also made its report, and thus the 3 committees completed their work and were discharged.

On Friday afternoon the ladies were treated to an automobile ride by the City of St. Paul. About forty of them toured the city and wound up at the home of Mr. and Mrs. John G. Hannahan in Merriam Park, where luncheon was served from which all returned in the evening highly pleased with the entertainment and with high praise of the hospitality of Mr. and Mrs. Hannahan.

Saturday

THE first order of business for Saturday was the election of officers; this took but very little time as the present officers had little opposition. The ticket of the previous 2 yr. was finally elected for the next term.

These were as follows: President, Matt Comerford, Brooklyn, N. Y.; 1st Vice-President, Milton Snellings, Rosslyn, Va.; 2nd Vice-President, T. J. Roberts, Oakland, Cal.; 3rd Vice-President, Michael Kelley, Cornwall-on-Hudson, N. Y.; 4th Vice-President, Michael Murphy, New York, N. Y.; 5th Vice-President, Will M. Finlay, Cleveland, O.; Secretary-Treasurer, J. G. Hannahan, Chicago, Ill.; Trustees, Sim J. Stevenson, Austin, Ill., Chairman; August Smith, Brooklyn, N. Y.; M. J. Cassidy, St. Louis, Mo.

After this came the fight for the convention city for 1914. Several cities were bidding for the convention, but the convention finally went to Peoria, Ill.

Just prior to the closing of the convention a resolution was introduced which dwelt at length on the hospitality shown the delegates by the citizens, of the cheerful welcome by the mayor of the city, and the pleasant entertainment provided by the local committee, and finally concluded with a rising vote of thanks to the mayor, the local committee and the citizens.

Supply Mens' Exhibit

PREVIOUS to the convention an invitation had been extended to the Central Exhibitors Association to exhibit at the convention. The exhibit was taken hold of by T. S. F. Hayes of St. Paul, representing the Dearborn Drug & Chemical Works of Chicago, and F. J. Camitsch of the Western Supply Co. of St. Paul, and they took steps towards arranging an exhibit in connection with the present convention. After consulting with William P. Lyons of the Lyons Boiler Works and others, space was engaged in the corridor of the Ryan Hotel, and an invitation to exhibit and to have a representative on the ground was extended to some 200 manufacturers and supply men. Of this number 31 responded by engaging space and either sending a representative or arranging to have a display in the exhibit hall.

Had the matter been taken up earlier a larger exhibit and more numerous exhibitiors would have been present. As it is the exhibitor's committee feel that the results obtained are most gratifying and that exhibits at future conventions may be made more gratifying and interesting if the I. U. S. E. so desires it.

The following houses exhibited and had a representative in attendance:

Dearborn Drug & Chemical Works, represented by T. S. F. Hayes, E. T. Ward, A. S. Cook; Western Supply Co., F. J. Camitsch; Quaker City Rubber Co., Chas. M. Pinchon and J. B. Freye; Lyons Boiler Works, Mr. Wanemaker; St. Paul Western Coal Co., H. C. Brown, Chas. Wanemaker; Hill Pub. Co., A. R. Maujer; Viscosity Oil, W. L. Beardsley; R. B. Whitmore & Co., A. E. Elliott; Platt Iron Works, J. F. Gould; Jenkins Brothers, J. C. McHugh; N. W. Electric Equipment Co., Neal Snyder; U. S. Graphite Co., Chas H. Schenk; W. S. Nott Co., J. H. Valles; Crane & Ordway, C. L. Olson; Westinghouse Air Brake Co., W. E. Lean; Hauks Price Co., Ben Hawks; Osborne Valve Co., A. H. Breach; St. Paul Electric Co., Chas. Horton; Valley Iron Works, Mr. Cameron; Rex Oil Co., Paul Swanach; American Huhn Metallic Pkg. Co., J. J. Schwende; Geo. M. Kemyon, C. L. Smith; Sim. D. Rollins & Co., Sim. D. Rollins; The Hill Pump Valve Co., Wm. F. Birch; Robinson Cary & Sands Co., Chas. Peters; Lunkenheimer Co., H. A. Burdorf; Plant Rubber Co., Chas. Faucett; The Southerland Carson Land Co., A. W. Southerland.

GET BUSY WITH the sunshine and forget the shadows and darkness.

OFTEN WE FEEL like kicking ourselves when we wouldn't let anyone else do it.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

NEW BUNDY STEAM TRAP

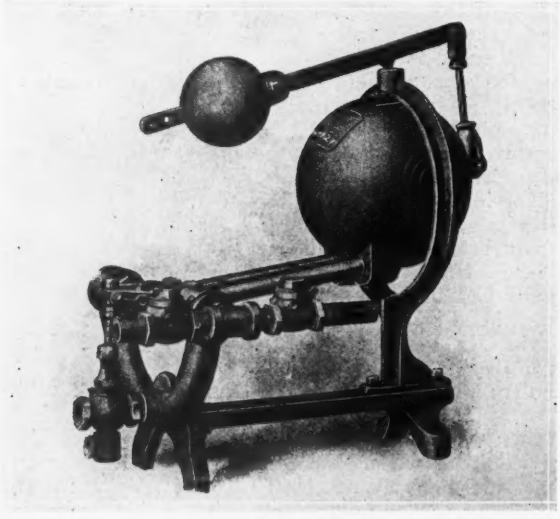
IN placing upon the market the new Bundy steam trap no new mechanical appliance is introduced, but with improvements it is the same Bundy steam trap which has been so well known for the past 20 yr.

With the advent of the Bundy trap an entirely new and original design of mechanical application was presented which at once placed and enabled it to maintain its leading position.

Its strong claim has always been: Full size openings; no internal reduction of areas; no internal mechanism hard to reach, every part being on the outside.

The new Bundy trap has maintained the same general principle in the construction and mechanism with some of the detailed parts improved.

The only objectionable feature in the original Bundy trap was the trunnion joint. The new Bundy trap has entirely eliminated this feature so the engineer



NEW BUNDY STEAM TRAP

will have no trouble with packing or leaky joints. These traps are absolutely water and steam tight under all conditions, requiring no attention from the engineer.

The capacities of the new Bundy trap are very much increased as the improvements enables it to work up to a much higher pressure, thereby giving it a larger range of usefulness.

The pear-shaped bowl has been replaced by a round bowl which is located so that the full weight of the water, when the bowl is filled, is at the extreme end of the leverage which gives to the new trap a very much greater power than the old trap.

Nashua Machine Co., Boston, is the manufacturer.

STEAM PIPE COVERING

New Material Especially Adapted for High Pressure and Superheated Steam Lines

AS many of our readers know, the Armstrong Cork Co. of Pittsburgh, is one of the largest manufacturers of cork in the world. Some 10 yr. ago it branched out into the cold storage insulation field—utilizing its waste cork for the manufacture of Nonpareil Corkboard Insulation and Nonpareil Cork Covering for brine, ammonia and ice water lines. This department of the business has grown rapidly and about a year ago, in order to distribute the insulating material to greater advantage, it was decided to add to its line a new type of high pressure and superheated steam pipe and boiler covering known as Nonpareil High Pressure Covering.

The diatomaceous earth, sometimes called infusorial earth, which is mixed with asbestos fiber to form this covering, is a peculiar substance of very low specific gravity, and is made up of the skeletons or shells of microscopic plants known as diatoms, which existed in the sea bottoms ages ago. It is practically pure silica, and the shells are so small that there are literally billions of them to the cubic inch. All are hollow and contain air.

In the form of plastic cement it has been used for years in Europe for heat insulating purposes. But, until the Armstrong Company discovered the process which it is now using, no satisfactory method was available by which it could be bonded together in sectional form so as to produce a strong, efficient pipe covering for high-pressure work.

It is claimed, and backed by tests, that this covering is exceptionally efficient as a nonconductor of heat; that it resists high temperatures without disintegrating, thus making it particularly well suited for the insulation of superheated steam lines, breechings, etc.; and that it is not affected by moisture or steam. It can be submerged in water for weeks, and after being taken out and dried will be found as strong and efficient as in the first place.

In the sectional form the sections are 36 in. in length and are furnished for all pipes of standard sizes up to 14-in. Pipes of larger diameter, boilers, breechings, etc., are covered with blocks. For insulating fittings and irregular surfaces cement is furnished.

IN OUR BOILER ROOM was a genius hailing from Sweden who was stronger on shoveling than on thinking and who preferred "alternate firing," that is, alternate periods of shoveling and rest, to continuous operation. Spite of all instruction and argument, he would pile in the coal until the fire was smothered and then be greatly astonished that steam would not hold up when there was "plenty coal in heem." After a particularly emphatic session with the chief, he came to me and said: "Aye tank that furnace bin no good. She don't combust some coal but leetle."

THE WATERTOWN AUTOMATIC SAFETY WATER GAGE

AUTOMATIC used in this connection implies affording positive protection from injury due to flying glass, and scalding by steam and water; and, too, in fulfillment of these requirements, the gage to be described has been approved by the Bureau of Steam Navigation at Washington, D. C., and the American Museum of Safety Appliances of New York City.

In the Watertown automatic gage, both upper and lower valves are identical in construction and can be interchanged, if desired. The highest quality of metal is used in a heavy construction which is carefully inspected, and tested to a high hydraulic pressure.

Referring to the sectional view, it is seen that between the shut-off valve and the steam and water passages is a chamber having a hard, accurately-ground, non-corrosive ball which, with its seat, constitutes the automatic feature of the safety device. At the bottom of the ball chamber is a threaded plug which can be removed for inspection and cleaning the chamber. To prevent the flying of glass a wire netting guard is furnished as standard equipment when desired, this shield being hinged to one of the rods

SECTIONAL VIEW OF WATERTOWN AUTOMATIC SAFETY GAGE

so that it can be opened for inspection or replacing the glass. When in operation, as the pressure is equal on both sides of the ball chamber, there is no force tending to hold the ball to its seat and the ball falls to the bottom of the chamber. This leaves the steam and water passages to the glass entirely free.

If the glass be broken, the pressure outside the ball valve is released and both balls are immediately raised to their seats by the internal pressure so that the rush of steam and water is checked. This action is so quick that steam glasses have been broken without the engineer being aware of the fact as there was not time for the jet of steam and water to force the glass out of position.

Although not recommended, the ball valves hold so tight that it is possible to replace the glass without closing the hand valves. An advantage of this is that in case the gage glass is too long to fit in between the nuts, either the top plug or the drain cock at the bottom may be removed and a new glass inserted through the body of the valve. Always the drain cock should be left open until the glass is replaced and the nuts in place in order to keep pressure off the glass.

As soon as the replacement is completed and the drain cocks closed, the balls will automatically release and open the gage as each ball seat has a small groove which permits a slight leakage of steam or water to pass so that the pressure on both sides of the balls is soon equalized and they drop, leaving the gage in regular operating condition.

Arrangement of the balls and seats is such that the ball will only stay seated when forced by a strong pressure of steam and there is no chance for the ball to stick on the seat and prevent accurate indication of the water level.

When the drain cock is open, the balls will be raised to their seats and close the valves so that to blow out the glass, the upper hand valve is closed until the extension of the stem lifts the ball from its seat and the steam pressure is forced through the glass.

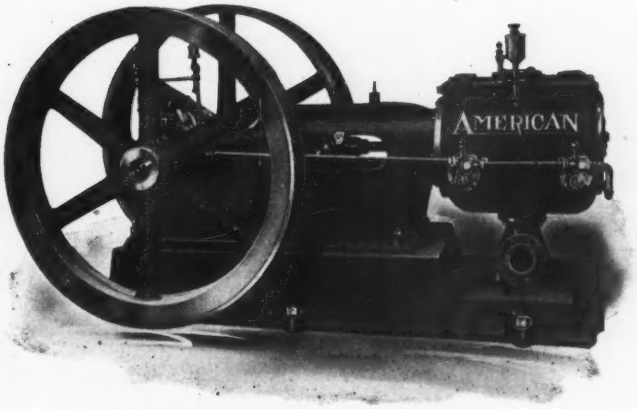
As all passage ways are straight, by removing the hand valves and balls, the valve bodies can be cleaned and inspected without removing the valves from the boiler, thus saving time, and damage to the threads, and the need of relining the valves after cleaning. As the upper and lower valves are interchangeable, a single extra valve carried in stock gives a replacement for top or bottom of any gage.

This little device is made by the Watertown Specialty Co. of Watertown, N. Y.

NEW LINE OF AMERICAN AIR COMPRESSORS

THE American Steam Pump Co. of Battle Creek, Mich., announce that it will shortly place on the market a new line of crank and flywheel air compressors. These compressors will be built with the same high grade of material and workmanship which characterizes the extensive lines of Marsh and American pumping machinery and will represent the latest and advanced ideas in air compressor design.

As will be noted from the illustration these compressors will be equipped with Corliss inlet valves



NEW TYPE OF AMERICAN AIR COMPRESSOR

which are mechanically operated. These positively moved valves open and close without impact, therefore being free from the hammering incident to poppet valves and insure a cylinder full of free air at each stroke of the piston even at moderate speed. The valves are so placed that they may be easily removed for inspection by removing the plain bonnet without disturbing the valve gear.

It is the intention of the above company to build these compressors in both the steam and power driven types in single and 2 stage patterns with capacities ranging from 150 to 650 cu. ft. of free air per minute. These machines in conjunction with their already complete line of Marsh and American steam and power driven compressors in the smaller sizes will place the American Steam Pump Co. in the front rank of air compressor manufacturers.

DAVID M. FORKER

IT was with deep regret that, as we were about to go to press, we received word of the untimely death of David M. Forker, Vice-President of the D. T. Williams Valve Co., Cincinnati, Ohio.

Mr. Forker was well known in business and social circles and was held in high esteem by all of his large number of acquaintances.

NEWS NOTES

ON OCTOBER 23rd examination will be held by the United States Civil Service Commission at all the principal cities throughout the country, to secure available names for appointment as Laboratory Assistant in Engineering in the Bureau of Standards at Washington and other branches, as vacancies may occur. The subjects required will be General Physics, Experimental Engineering and Theory of Materials and Experience, each of the first 2 subjects to count 25, and the last to count 50. Applicants must be between 20 and 35 years of age, citizens of the United States, and have been living at least one year in the state or territory where they take the examination. Application should be made to the U. S. Civil Service Commission, Washington, D. C., for Form 1312, in regard to the examination for Laboratory Assistant in Engineering. The salary for the position is from $900 to $1200 a year.

FOR THE CONVENIENCE of middle Western customers, J. H. Williams & Co., makers of Diamond W Drop-forgings, Brooklyn, N. Y., have opened an office and warehouse at 40 South Clinton St., Chicago, Ill., where a stock of their many drop-forged specialties will be carried on hand.

GOLDEN-ANDERSON VALVE SPECIALTY CO. of Pittsburgh, announces that The United States Steel Corporation has ordered 1045 Golden-Anderson cushioned triple acting and non-return valves.

THE KERR TURBINE CO., of Wellsville, N. Y., has found it necessary to open its own office in Pittsburgh, to take care of increase business in that district. The new office will be located in 2137 Oliver Bldg., and in charge of R. M. Rush, formerly with the Dravo-Doyle Company. With Mr. Rush will be associated F. B. Allen, formerly of the Cleveland office of the Cooper-Hewitt Co.

THE OFFICE of the New England Association of Commercial Engineers has been removd to 15 Federal St., Boston, Mass., where visitors will now be welcome and every assistance given.

THE JAPANESE GOVERNMENT, through the Department of Railways, has authorized Prof. E. C. Schmidt, of the University of Illinois, to design a dynomometer car for use on the government railways. The car will be constructed in this country, under Prof. Schmidt's supervision, and will be of the hydraulic type to measure tractive effort up to 80,000 lb.; also speed, distance, vibration, buffer thrust, etc., up to a speed of 85 miles per hour. The car is to be delivered next spring.

NEWS NOTES

MR. J. McA. DUNCAN has been appointed district manager of the Westinghouse Electric & Mfg. Co. for the Pittsburgh district in place of Mr. W. F. Fowler, who has resigned to accept a position with the W. S. Kuhn Corporation. The Pittsburgh sales office has charge of all the sales for the Pittsburgh district and is one of the most important of the offices maintained by the electric company.

Mr. Duncan has been in the employ of the Westinghouse Electric & Mfg. Co. for about 25 yr., and is one of the original group of 8 men taken from the Union Switch & Signal Company, then located on Garrison Alley, Pittsburgh, to form the electric company, which was established at the same place. His first position was in the shipping department, where

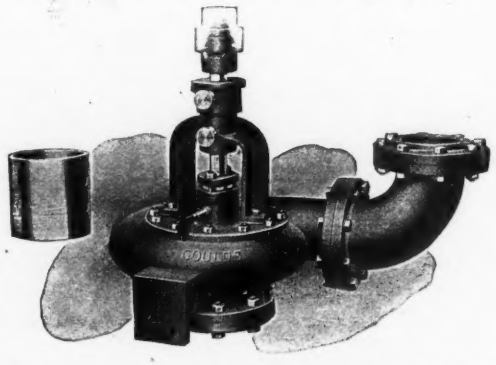
J. McA. DUNCAN

his ability was soon proved to the satisfaction of his employers, and he was placed in the correspondence department, of which he was afterwards in charge. In this position he had charge of all railway and lighting apparatus made by the rapidly growing company.

In 1906 he was placed in charge of the price department, and, as head of this division of the company, passed on prices of all apparatus manufactured. For a year or 2 he was located in the New York office on some special work in connection with the costs. Mr. Duncan then returned to East Pittsburgh and was attached to the Manager of Works' Office as Director of Costs, and later as Assistant Manager of Works in charge of production and costs. Last spring, when the present revival of industry began, the increased activity resulting from the additional business secured necessitated a division of work, and Mr. Duncan was apointed Director of Works Accounting.

He has assumed his new duties with the office in the Union Bank Building, Pittsburgh, Pa.

ADDED TO THE NEW line of centrifugal pumps developed by The Goulds Manufacturing Company, Seneca Falls, N. Y., is the vertical type illustrated herewith is for service where it is necessary to pump from a pit. It can be operated submerged when this is desirable. The impeller is of the enclosed type; and the design is such that the end thrust is practically negligible. A ball thrust



bearing carries the weight of the impeller and shaft. A water sealing ring is provided, making it unnecessary to draw the gland up tight, insuring low friction losses. For special liquids which attack iron, this pump can be furnished brass fitted or made entirely of brass. It is adapted for belt drive or direct connection to electric motors or other drivers.

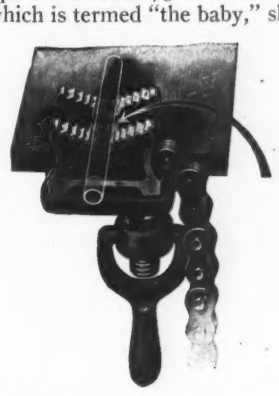
ANNOUNCEMENT is made of the formation of the firm of Wightman & Richards, being the technical department of Jos. A. Richards and staff, general advertising agents, Tribune Bldg., New York City. The technical department will include Lucius I. Wightman and Paul Morse Richards, both of whom have had long experience in the field of technical journalism and advertising. Mr. Wightman is a graduate of the School of Engineering, University of Colorado, as electrical engineer, with 5 yr. experience as a draftsman, designer, chief engineer and superintendent of electrical construction for power plants, hydro-electric installations and electrical machinery. He has also been connected with the Compressed Air Magazine as business manager and has had charge of the advertising for the Ingersoll-Sargent Drill Co. and Ingersoll-Rand Co., of New York, for 6 yr., for the De La Vergne Machine Co. for 2 yr., and for other firms. His book on Compressed Air is used as a standard authority and he has also written on Tunnels and Subways, the Catskill Aqueduct and various articles for Practical Engineer on subjects relating to compressed air. Mr. Richards is a publisher, sales manager and advertising man of wide experience in the technical field. The experience of the men and the character of the firms whose advertising they have handled is guarantee of their ability to give satisfactory service in the handling of technical advertising.

WM. C. ROBINSON & SON CO., of Baltimore, Md., has recently been awarded one of the largest oil contracts ever given out by the Navy Department. This calls for a supply for all ships that have turbines or forced speed amounting to several hundred thousand gallons of marine turbine oil and machine oil and running up between $50,000 and $60,000. Several hundred carloads of oil will be shipped to all navy yards on the Atlantic seaboard.

YORK MFG. CO. reports the following recent installations: Blumenthal residence, New York, N. Y., one 4-ton compression side and refrigerating plant; Stickel Hygeia Ice Cream & Ice Co., Hackensack, N. J., one 25-ton complete can ice plant; Colley & Billingsby, Stockdale, Texas, one 11-ton belt-driven refrigerating compression side, and one 3-ton can ice making plant; A. T. Kellogg, Trancitas, Texas, one 6-ton belt-driven refrigerating compression side, and 3-ton raw water can ice plant; Missouri State Penitentiary, Jefferson City, Mo., one 75-ton horiozntal, double-acting, steam-driven refrigerating compression side, and one 20-ton can ice making plant with distilling system; Hershey Chocolate Co., Hershey, Pa., one 65-ton vertical, single-acting, belt-driven refrigerating machine, balance compression side, 135 cans capacity, with double pipe ammonia condensers; Hampton Produce Co., Hampton, Iowa, one 10-ton horizontal refrigerating compression side, and direct expansion refrigerating plant; F. W. Webber, Oak, Fla., one 4-ton refrigerating compression side; J. W. Hennion, Paterson, N. J., one 4-ton refrigerating compression side, and refrigerating plant; Wm. Zoller Co., Pittsburgh, Pa. one 10-ton flooded freezing system, and distilling system; Kent Co. Ltd., Montreal, Canada, one 30-ton refrigerating compression side for Moose Jaw Cold Storage Co., Moose Jaw, Saskatchewan, Canada; Jacobs Bros., Nashville, Tenn., one 11-ton refrigerating compression side, and brine refrigerating plant.

A STEAM TURBINE driven centrifugal pump of 100,000,000 gal. per day capacity is to be installed in the Ross Pumping Station of the Pittsburgh Water Works by the De Laval Steam Turbine Co., of Trenton, N. J. This pump will be the largest steam turbine-driven centrifugal pump ever built in this country, the rated capacity of 100 million gallons per day against a total of 56 ft. amounting to over 980 water hp. The pump is guaranteed to show a duty of 115,000,000 ft. lb. per 1000 lb. of dry steam, all steam used by the condensing equipment being charged to the main unit.

THE ORIGINAL VULCAN CHAIN vise manufactured by J. H. Williams & Company, N. Y., has been improved and additional sizes have been made which will care for all pipe sizes from ⅛ to 8 in. diameter. The smallest size, which is termed "the baby," shown herewith,



is manufactured with an added improvement, consisting of an extended tooth, which enables the extreme of chain grip without bending or injuring the smallest pipe. The vises are made entirely from wrought steel. The drop-forged jaws are of steel tempered for file sharpening.

BULLETIN NO. 4943, recently issued by the General Electric Company, illustrates and describes direct current motor-starting panels designed to meet the demand, especially from the steel and cement industries, for motor-starting equipments, strongly constructed and liberally proportioned, and provided with safety adjustments which will render the equipment safe and reliable in the hands of unskilled operators.

BOOK REVIEW

THE TWENTY-FIRST ANNUAL 1912 edition of Hendricks' Commercial Register is a most complete edition representing 1574 pages, an increase of 155 pages since the 1911 edition. The index has 14 additional pages, showing an addition of 5768 new manufacturers not shown in 1911. The aim of the Register is to furnish as complete classified lists as possible of manufacturers covering the architectural, engineering, electrical, mechanical, railroad, mining, manufasturing and kindred trades and professions. It is one of the most complete works of its kind and by actual office use has been found to be accurate and reliable. Over 50,000 classifications are made representing manufacturers or dealers of some machine, tool specialty or material under the lines mentioned above. The classifications are simply arranged so that the books can be readily used for either purchasing or mailing purposes. The classification is first of manufacturers of a peculiar trade under a general heading and each firm or corporation is then placed under as many classifications as its products call for. Another convenient feature is that trade names of articles are given as well as the names of the manufacturers which is often a great convenience when making purchases. The Register has been published annually for 21 years and has given uniform satisfaction to users throughout this period. It is expressed to any part of the country on receipt of $10 by F. E. Hendricks Co., 74 Lafayette St., New York, N. Y.

ELECTRICAL INJURIES, Their Causation, Prevention and Treatment, by Charles A. Lauffer, A. M., M. D. New York, John Wiley & Sons. Bound in cloth, 4 by 6½ in., 77 pages, price 50 cents. The author of this book is connected with one of the largest electrical manufacturing companies in this country and has had extensive experience in treating electrical injuries.

The nature of various results from such injuries are described and the different forms of treatment are fully explained. Plain language is used so that the book's real field is in the hands of practical men.

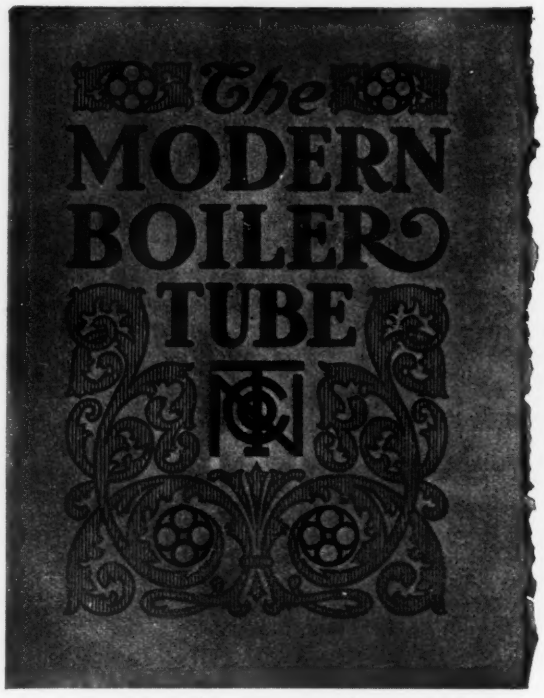
THE GAS ENGINE IN Principle and Practice, by A. H. Goldingham, 6 by 9 in., bound in cloth, 195 pages, New York, Spon & Chamberlain. This book includes a comparison of the 2-cycle and 4-cycle types of internal combustion engines with a description of various designs. In addition there are notes on suction and pressure type gas producers and crude oil vaporizers.

"THE SUBWAYS AND TUNNELS OF NEW YORK," the title of a book of 372 pages by Messrs. Gilbert, Wightman and Saunders, telling how the big problems of construction of these immense engineering works have been solved up to the present. It is an interesting record of achievement filled with valuable information on the engineering features of the work. It is published by John Wiley & Son, of New York city.

CATALOG NOTES

BULLETIN, FORM 4017, describes a new line of "Butterfly" Hand Hammer Drills manufactured by the Ingersoll-Rand Co., 11 Broadway, New York City. These drills are adapted for such work as pop shooting, breaking up boulders, trimming walls, and all work requiring holes not exceeding 5 ft. in depth. Catalog illustrates the various types and sizes as built and a sectional view on the last page shows the duplicate parts.

THE NATIONAL TUBE CO., of Pittsburgh, has recently issued a booklet entitled The Modern Boiler Tube, which gives a historical sketch of boiler tubes and an introduction which is followed by descriptions and illustrations of tests made upon steel tubes, and also



gives standard specifications and a summary of proceedings of the International Master Boiler Makers' Association for 1909, 1910 and 1911. This booklet cannot fail to interest any one in a power plant.

THE BIGELOW CO., of New Haven, Conn., has recently published 2 interesting catalogs, one of the Bigelow fire tube boilers, the other on the Bigelow Hornsby water-tube boiler. Views, tables and data are given showing the different styles of setting and description with instructions how to design and build the brick work, with data on boiler bracing.

It's a handsome as well as an instructive catalog and tells the details of boiler construction, and in the latter part shows the different types of the Bigelow-Manning boiler. Locomotive boilers, small, upright boilers, internally fired boilers of the Continental type and arrangements of smoke flues and stacks are among the contents.

The water-tube boilers are made in unlimited size of 2500 rated horsepower or more and are designed especially for flexibility of construction, the tubes being arranged in several inclined and vertical banks. The catalog illustrates and tells how accessibility, high rate of steaming and sustained economy are secured by the construction shown. Either or both of the catalogs may be had by writing to the Bigelow Co., and mentioning Practical Engineer.

A SHORT TALK on bearing bronze is the title of a folder sent by A. Allen & Son, 486 Greenwich St., New York, giving the essential qualities of a high grade bearing bronze. The points are made concise but clear so that they are easily comprehended.

Sparks From The Advertising Pages

It is estimated that 85 per cent of the value derived from advertising is cumulative.

So say the statistical experts in the publicity business and since they bring forth some convincing data to prove their point, they would seem to be correct.

By the term cumulative, advertising men mean "stored up" value; and when they say that 85 per cent of the value derived from an advertising campaign is cumulative, they mean that the immediate and direct returns will represent only 15 per cent of the good that the campaign is doing the advertiser.

This conclusion was reached by an investigation into the results obtained by five advertisers. Their products were practically alike, each spent the same amount of money annually, and the fields to which they advertised were similar.

The only difference was in the time at which they began to advertise. Each of the five was just a year apart in this respect.

One of them had been advertising for five years, another four, another three, still another two, while one had just completed his first year.

A careful analysis of the results obtained by the advertiser who had completed his fifth year and the one who had completed his first year, showed that the latter was obtaining just about 15 per cent of the total results obtained by the former, despite the fact that both were using the same amount of space in the same mediums. The intermediate advertisers, it was found, were obtaining results proportionate to the length of time during which they had been advertising.

This big difference in the results of the fifth year and the first, although seemingly extraordinary, is in reality, very easily explained.

It is due largely to the fact that the confidence of the public increases as the reader sees the product continually and consistently advertised through a long space of time.

"Time proveth all things," the saying goes; and there's nothing like keeping everlastingly at it to break down skepticism.

It has been said that most of the money wasted in advertising can be charged up to the "once-in-a-whiles" and "inconsistents." There would certainly be fewer advertisers of this type if they all realized that the above percentage is a fact.

Most advertisers do realize, however, that the immediate and direct returns which they receive constitute only a part of the ultimate value of their advertising and it is only common business sense that prevents them from investing good money to advertise a product that is not by its very excellence proof against the test of time.

Look at it from whatever angle you will and you cannot come to any other conclusion than that the advertised products are the thoroughbreds of merchandise.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 30 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office 10 days preceding publication.

Positions Wanted

POSITION WANTED—As engineer or master mechanic in Montana mine. Must leave present locality because of ill health of family. 41 yrs. of age. Wide experience throughout the world as engineer of mines and marine engineer. Hold first-class engineer's license for Massachusetts and an unlimited 2nd assist marine U. S. engineer's license for ocean steamers. Address Box 253, care of Practical Engineer, Chicago, Ill. 10-15-1

POSITION WANTED—Engineer with 10 years experience operating and installing steam, electrical, and refrigerating plants. I. C. S. graduate; married. Total abstainer. Desires day position in medium size town. Middle West preferred. Address P. O. Box 178, Mound City, Mo.

POSITION WANTED—By an engineer with 12 years experience in heating, lighting and ventilating in educational institutions. Married. Age 39. Best of references. Address Box 250, care of Practical Engineer, Chicago, Ill. 10-15-1

POSITION WANTED—In small power plant or mill as oiler or fireman. Four years' experience with tractions. Handy with tools. An all around man. Sober. Single. Please give full details in reply. Address E. B. Stewart, Racine, Minn. 10-1-2

POSITION WANTED—By young man who has completed a course in electrical engineering. A place in light plant where there is a chance for promotion is desired. Will work one month without pay for experience. Employed at present as steam engineer. Address Jack McDaniel, Tillsboro, Texas. 10-15-1

POSITION WANTED—By A1 engineer. Understands slide valve and Corliss engines, lighting plants. Have handled 12-ton ice plant, compression system. Address Box 248, care of Practical Engineer, Chicago, Ill. 10-1-2

POSITION WANTED—Managerial position with Gas Company. Can handle all parts of the work. Plant operating, laying mains, salesmanship, maintenance, office work, etc. Best of references. Address Box 251, care of Practical Engineer, Chicago, Ill. 10-15-1

POSITION WANTED—As engineer in small, or assistant in large, plant. Age 24. Have Ohio license. Can give best of recommendations. Experienced with high and low speed engines and plant lighting. Address Box 252, care of Practical Engineer, Chicago, Ill. 10-15-1

Help Wanted

WANTED—Inventors to work on salary. National Invention Corporation, 302 Hill Bldg., Nashville, Tenn. 10-15-1

HELP WANTED—ENGINEER WANTED in every city and town to instruct our customers in indicator practice. If yau have a fair working knowledge, we will "do the rest." Good pay to reliable, intelligent men. Write for particulars. Lippincott Co., Newark, N. J. tf

AN EXTRAORDINARY OPPORTUNITY for party or parties with some knowledge of mechanics, not necessarily practical, with small capital. State or county rights for sale of an established patented device. Quick sale in all manufacturing districts. Exceptional profits. Address P. O. Box 489, Trenton, N. J. 10-15-2

Wanted

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf

WANTED—January 1910 issues of Practical Engineer. Your subscription extended 6 months for every copy of this issue sent us. Offer good until Nov. 1st, 1912. 10-1-2

WANTED EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. tf

For Sale

FOR SALE—HIGH PRESSURE BOILERS, 54x16, 60x16, 66x16, 72x18. Corliss Engines 10x30, 12x36, 14x36, 16x42, 18x36, 18x42. Generators, Motors, Miscellaneous Machinery. The Randle Machinery Co., 1767 Powers St., Cincinnati, Ohio. 7-15-6

FOR SALE—New 30 H. P. Ball Automatic Horizontal engine. Lucas & Son, Bridgeport, Conn.

FOR SALE—INDICATOR REDUCING WHEEL, planimeter, best make, in fine order. Examination allowed before payment; price low—in fact, a sacrifice. Address Mrs. N. L. Browning, East Orange, N. J. tf

FOR SALE—16x36 Hamilton Corliss engine in perfect condition, $500; 72 in. by 18 ft. HRT. Boiler 125 lb. Insurance, $350. Duzets & Son, Hudson Terminal, New York. 10-15-1

Patents and Patent Attorneys

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owen Bldg., Washington, D. C. tf

PATENTS BRING WEALTH; proof—books—advice—Free. Low rates, easy terms. A. Wedderburn, Pat. Atty., Washington, D. C. 9-15-3

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf

THE PATENTOME is interesting and instructive. A liberal education in patents and how to get them. Free on request. Established 1865. Anderson and Son, Patent Solicitors, 710 G St., Washington, D. C. 10-1-2

FIND OUT FOR YOURSELF what to invent and how to procure and sell a patent for the same. My book, "Inventor's Universal Educator," covers the matter from A to Z. 140 pages, elegantly bound. Also contains 600 mechanical movements and 50 perpetual motions. Price $1.00, postage free. Money returned if not more than satisfactory. F. G. Dieterich, 618 Ouray Bldg., Washington, D. C. 10-1-2

Miscellaneous

IRON, BRASS and Aluminum Castings, Metal Specialties, Patterns, Models, Polishing, Plating and Japanning, North Chicago Tool Works, 65 Grove Ave., North Chicago, Ill. 6-1-12

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. tf